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Electrical Review

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OUR NEW YEAR DOUBLE NUMBER.

The ELECTRICAL REVIEW extends the most cordial New Year's greeting to all its friends. Realizing that the past year has been one of great material advance in the electric arts, and that the prospect for the coming year is such that it will almost certainly be the greatest season of progress that the industry has known, it has been deemed proper to acknowledge these conditions by an issue that would fitly typify the present status and achievement of electrical engineering. The ELECTRICAL REVIEW, therefore, is celebrating the advent of the new year by making its initial appearance in its new dress of type and more convenient form.

IS TRANSATLANTIC WIRELESS TELEGRAPHY POSSIBLE?

There has been much loose talk about the bending of the radiations, whatever may be their nature, that are used in wireless telegraphy, around obstacles and around the curvature of the earth's surface. Over the comparatively smooth and unobstructed surface of the sea it is certain that signals have been exchanged over a distance implying a bending of the electrical impulses about one and one-half degrees from a rectilinear course. From this premise certain investigators have jumped to the conclusion that sufficiently powerful electrical disturbances emanating from a wave-radiating source would bend around the curvature of the earth between this country and Europe. If this is possible it implies diverting the electrical impulses by nearly a right angle from their initial course. If they will turn through one right angle it is perfectly reasonable to suppose that they may be made to turn through two, three or even four, which begins to look a little like an absurdity.

Just what is the necessity for assuming that these influences travel as electric waves, with a wave-front capable of swerving when it meets an obstacle, is difficult to see. In all the wireless telegraph work that has been done so far the vertical elements of the sending and receiving circuits have been approximately parallel, or in the most favorable position for mutual electro-magnetic induction. Is not a perfectly sufficient explanation of the actions noticed found in ordinary induction? When currents rush up and down in a vertical wire the whole surrounding neighborhood is filled with complex surges of magnetic potential. A parallel wire receiving them exhibits electro-motive forces corresponding exactly to their movement with relation to it. Now it is, of course, true that equipotential surfaces of magnetic potential moving out from a current-carrying wire are, in a sense, wave fronts, but they are certainly not what are commonly called electric waves or Hertz waves. They fill the whole of space, theoretically speaking, except where conducting substances exist, and it is difficult to screen an object from them—to form an electro-magnetic shadow—except by actually enclosing it in a good conductor. Hence, to argue that a dome of sea-water, requiring the influence to bend only about one or two degrees, means the possibility of transatlantic wireless telegraphy seems meaningless, because if actual electric waves of the Hertzian variety are in question the deduction is on too slender a premise, and if electro-magnetic induction is the explanation, vertical wires on the two sides of the Atlantic would be nearly perpendicular to one another, or in the least favorable position. It seems worth while for some one to try the transatlantic experiment and set the whole matter at rest.

Some remarkable figures are given in Mr. E. W. Caldwell's article in this issue on the Energy of Telephone Currents. It is not generally known that these currents have an appreciable value, and that the output from the secondary of the transmitter induction coil should ever rise above one watt is astonishing. The great importance of securing telephone currents of larger power is well shown in the article and should stimulate inventive work in that direction. Word has come recently from France of some advance made in this direction by the multiplying of transmitters, but it does not seem that this direction of study promises any great results.

AMERICAN ELECTRICAL PROGRESS DURING 1899.

A YEAR'S HISTORY OF THE DEVELOPMENT OF ELECTRICAL ENGINEERING AND INDUSTRY IN THE UNITED STATES.

BY CHARLES T. CHILD.

It has been said that the happiest nation is that which has the least history. To a certain degree this is also true of industries and periods: it means that a prospering engineering industry is too busy for revolutionary developments, and that a season of intense industrial activity is rarely marked by great progress in invention.

It is to these limitations, set by an enormous and increasing activity in all directions, that the comparatively unprogressive development of the electrical industry in the United States for the last year is due. There has been enormous development, wonderful growth, a vast increase in investment, but little invention and small outcome from explorations of the outlying fields of unknown phenomena. It is as if the pioneer had become the husbandman, and abandoned the search for new fields for the tillage of the region he has already conquered. The inventor has stopped for the moment to become the manufacturer, and the manufacturer is too busy to invent.

Perhaps the most striking feature of the year's work has been the development of the electromobile and its growing use for the transportation of passengers and merchandise. It no longer attracts attention upon the streets of our cities, but has become a familiar object. Notwithstanding its popularity and the increase of its use, however, much remains to be done before it meets fully the ideals of its constructors. Its weight—which means, to all intents and purposes, the weight of the batteries it carries—must be reduced. Its design is still that of the horse-drawn vehicle minus the horse, and its range of travel on one charge is still too small. At the same time its present high price is a hindrance to its larger use and more general popularity.

But the year has brought important betterments to the electromobile. Through the formation of strong companies for the manufacture and exploitation of electric vehicles the work of experiment and invention has been carried on under highly favorable conditions. Great sums of money have been invested to secure the services of the best men, to inaugurate the manufacture of vehicles and batteries upon the best lines, to test the availability of the product in competition with horse-vehicles and other forms of automobiles. It may be said that the industry is to-day in about the same position as the electric railway was eleven years ago, and its promise is little, if any, less than was that of the trolley car in its early days of experimental and financial vicissitude.

The electric street railway in America has reached a point in its development which is very near perfection. The features of its progress during last year were, most notably, the extension of conduit conductor systems and the consolidation of minor interests into large corporate bodies of great power and strength. With this consolidation has come, in most cases, a distinct betterment of service, an extension of transfer systems and a better fulfillment of the duties of public service corporations. The perennial conflicts between street railway companies and their employés have not been absent, but have been shorter in duration and less destructive than heretofore. In Cleveland, Ohio, however, there was an outbreak of anarchistic spirit that resulted in some destruction of property and bloodshed, but the difficulties there seem to have been finally adjusted.

In New York city, Washington and other places, the underground conductor system, employing an open-slot conduit, has replaced cable and horse railways, and large sums of money have been invested in these lines. A feature of the great installation of the Third Avenue Railroad Company, in New York, is the employment of a gigantic generating station, of 80,000-horse-power capacity, with high-tension polyphase-current distribution to substations, where the current is transformed and converted to direct current for supply to the cars. The entire conducting system, which is still in process of installation, is underground.

The management of the Manhattan Elevated Railroads, in New York, after several years of indecision and contemplation, and doubtless spurred by the serious competition of the conduit-system surface roads paralleling them, have contracted for the electrical equipment of their entire system, and expect to have some of the lines in operation with electric power before the end of the year 1900. On this system, also, high-tension polyphase distribution, with converter substations, will be used.

The central power station for the elevated railways will be of great size, no less than 70,000 horse-power being contemplated, and the dynamos installed in it will be the largest in use—each of them of more than 6,000 horse-power. It has been wisely decided to erect it on a site that will be nearly central to the probable system of elevated railways 20 years hence.

In the application of electric traction to existing steam railways the year has witnessed the continued successful operation of two divisions of the New York, New Haven & Hartford Railroad, and the extension of the electric system to another section of its lines. In the middle western states very long interurban lines have been constructed, or formed by the amalgamation of existing lines, and many of these are worked from single power stations on the polyphase transmission and converter substation system. One, at least, of them is over 40 miles long. Electric locomotives for shunting and handling steam railroad freight cars in terminal and factory yards are also meeting with increasing favor and are in use in many cities.

The construction of electric railways has been standardized to a point of such completeness that a description of one line or station is almost equally descriptive of all. The use of direct-coupled generating units has become general, while switchboards, line material, tracks, etc., are all of standard patterns, differing little in various installations. There has been no notable improvement or change in car equipments; two four-pole enclosed, single-reduction gear motors, operated by a modification of the series-parallel controller, having a magnetic blow-out extinguisher for the arcs formed during its working, being the practically universal type. In the larger cities there has been a growing tendency toward the use of double-truck cars.

It may be instanced, as an example of the growth of interurban trolley lines in closely populated districts, that a journey may now be made in electric cars from Paterson, N. J., via New York city and Boston, to Portland, Me., with only three breaks, aggregating about 14 miles, in a total distance of about 360 miles.

The meeting of the National Electric Light Association, which was held in New York last May, was one of the best attended and generally profitable gatherings in the history of that body.

The electric lighting industry is in an active and flourishing condition. Its progress during the year has been notable in two directions—the consolidation of systems, resulting in great extension of areas lighted from single station, and the increasing use of alternating current for arc

lighting and as a basis for distribution systems.

In some of the larger American cities, notably in Chicago and Brooklyn, by various consolidations and absorptions, the whole of the electricity supply for lighting and power purposes over large urban areas has been merged, and the economy of generation on a vast scale and distribution from a single point has been attained. In Brooklyn, notably, the area served from a single station is very large, embracing more than 100 square miles. In the great generating stations in that city, two in number, three-phase current at 6,600 volts is directly produced at the dynamo and fed by subterranean conductors to substations. In these it is transformed to lower voltages for distribution as alternating current, or converted into direct current for feeding nearby lamps and motors. Some part of this high-tension current is also utilized to drive synchronous motors coupled to arc dynamos for the supply of constant direct current to arc lamps.

In these stations economies only possible in very large centres of distribution can be practised. Among these are automatic methods of handling coal, stoking, removing ashes, etc., greatly reducing the cost of labor. Strangely enough, at them no current directly available for electric lighting is generated; it is all transformed, first in one way or another, before it reaches the premises of the consumer. It is intended, at some of these larger stations, to experiment on a large scale with rectifiers for arc lighting, the installations of these machines so far being of rather small proportions.

The enclosed arc lamp, which leaped into sudden favor upon its introduction a few years ago, has assisted in solving the difficult problem of arc lighting with lamps in series on alternating-current circuits. During the year several installations using alternating current of a moderate periodicity, generally about 60 cycles per second, with such lamps have been started and have shown good commercial and financial results. The current of the single-phase variety is generated by the usual constant-potential dynamo, and is led through the primary of an open core transformer adapted to have a high magnetic leakage. In the varying field of this primary, the secondary coil is suspended by a system of levers and counterbalance weights, its position being determined by the repulsions between it, the core, and the primary coil. In this way, excellent regulation for constant current is had in the secondary, which feeds the arc-lighting circuits.

The enclosed arc lamp is almost universally used where arc lights are required indoors and direct current of constant potential is available. The alternating type of enclosed arc lamp has also been greatly improved in the last year, and is now taking its place beside the direct-current type as the standard device for interior arc lighting. The use of these lamps in street lighting from low-tension, direct-current mains has greatly increased in the larger cities, and they have given satisfaction to municipal authorities and the public alike.

A feature of electricity supply in our cities for the past year has been a falling off in the strength of the movement toward municipal ownership of electric light stations. It seems that rational ideas on the subject of public service supply corporations are supplanting the visionary and often selfish theories that have been exploited for several years with the aid of a powerful journalistic propaganda. The showing made by the notable municipal lighting plant of the city of Detroit has not been encouraging to the friends of public ownership of such utilities.

Another interesting phase of electric lighting has been the increased use of electric signs and of electric light for advertising and display purposes. The electric sign, or sign made of electric lamps clustered closely together, has made a strong impression upon popular fancy and has supplied the stations with profitable long-hour customers. In New York, Chicago, Boston and other large cities, the use of these signs has added very noticeably to the illumination of the principal streets.

On the occasion of Admiral Dewey's return, in September, the widespread use of electric light decorations on buildings and public places in New York made a display of electrical illumination which has never been surpassed. The electric sign erected on the Brooklyn Bridge for the occasion contained over 8,000 16-candle-power lamps, and was visible and readable many miles away.

In the electrical transmission of power there has been much development, but for the most part along well-known lines. Some long and important new transmission lines were built in 1899 in the Pacific coast states, notably the 43-mile line of the Mount Whitney Power Company in California. At Niagara Falls there has been much extension of the power supply industry, while the middle of the year saw the whole of the electric lighting system of the city of Buffalo operated by Niagara power. Perhaps the most notable feature of the new installations has been the use of aluminum wire in place of copper in the transmission lines. Throughout the year the price of copper wire had been very high, and the scarcity of the metal such that deliveries of wire were slow. Meanwhile the cost of aluminum, reduced from its ores on a large scale by electrolytic processes, had fallen until it was at a figure such that equal conductivity in this metal cost less than in copper. The fine transmission line from Snoqualmie Falls, in Washington state, was built of this metal, as were lines at Hartford, Ct., and elsewhere. Much of the metal has also been used in switchboard work and for shorter lines of conductors for large currents.

In the applications of electric power from stationary motors, there has been a gratifying increase. Particularly in the design of motors for direct attachment to printing-presses, machine tools, etc., there has been a considerable advance, and many large manufacturing and industrial plants have established systems for the distribution of power through the agency of electricity. Of these, perhaps, the great abattoirs and packing-houses of Armour & Company, in Chicago, are the most noteworthy example. The installation of dynamos, motors and conducting systems now being placed in these establishments will, it is said, represent an investment of more than a million dollars.

Of all the installations for electrical power distribution that have been constructed during the year, however, the most interesting in many ways is the equipment of the two new battle-ships, Kearsarge and Kentucky, of the United States Navy. On these ships central power plants, forward of the main propelling engines, furnish electric power to all the auxiliaries of the vessels except the anchor windlasses, capstans and steering gear. For ventilating, turning turrets, training guns, hoisting ammunition, working boat and coal hoists, etc., electric power is used throughout. The tests that have been made so far, though not exhaustive, are eminently satisfactory.

In the applications of electricity to the chemical arts and manufactures much was done during 1899, though only one new process was introduced—that of making graphite. The reduction and refining of copper employed an enormous aggregate of power, while vast new works for the manufacture of calcium carbide were under construction to supplement those already in operation at Niagara Falls and elsewhere. Similarly, the production of alkali and bleaching powder has employed much electrical energy. The output of carborundum and aluminum has greatly increased, the demand for the latter having been much stimulated by

the high price of copper and by its growing use in the hardware and other trades.

An interesting experiment has been made, with satisfactory and practical results, by officers of the United States Army at Havana, in the production of a disinfectant fluid from sea-water by electrical means. Large tanks of the salt water are electrolyzed between carbon electrodes, the salt being decomposed into sodium hydroxide and chlorine, which, in its nascent condition, reunites with the hydroxide and water to form a series of chlorites and hypochlorites very valuable as disinfectants. These remain in solution, and it is said that the use of this electrolyzed sea-water has already materially benefited the sanitary condition of the city.

The telephone occupied the centre of the stage, so to speak, during the past year, the situation of the telephone industry being interesting in the extreme. The movement of the independent companies, those not operating under licenses from the Bell parent company, toward unification was suddenly accelerated by the appearance of a corporation with large capital and strong financial personnel, which proceeded to acquire a large number of them with the avowed purpose of forming a powerful anti-Bell concern. This movement has not yet progressed far enough to warrant an opinion as to its outcome, but the new organization is of undoubted strength. Meanwhile, the suit brought in Boston to test the validity of the Berliner telephone transmitter patent on its merits awaits decision.

The American Bell Telephone Company has been lately absorbed by one of its own progeny, the American Telephone and Telegraph Company, commonly known as the "Long-Distance Telephone Company." The object of the purchase of the parent company was to allow an increase of stock permitted by the laws of New York state, under which the subordinate organization was chartered, but forbidden by those of Massachusetts, which state chartered the American Bell company. It is needless to say that the latter concern was in a highly prosperous condition when the change was decided upon.

In telephone engineering the marked features of the year's work have been the installation of the common-battery system in the large exchanges in New York and Brooklyn, the growth of long-distance lines, and the building of toll-lines from town to town, especially under the auspices of the independent companies in the middle west. The common-battery system is one in which the batteries furnishing energy to the transmitters at subscribers' stations are grouped at the exchange instead of being distributed at the individual stations. It possesses numerous advantages over the distributed battery system, among them quickness of operation and facility of inspection. In several of the exchanges in the various boroughs of New York city the change to this system has already been made, and it is expected that all the exchanges in the city will be in operation under the new method in about one year.

The network of toll-lines owned or controlled by the independent companies covers the country from West Virginia to North Dakota and southward to Kentucky and Missouri, linking the towns together. In these districts what are called farmers' community telephone systems are finding a large extension. These consist of a simple variety of party-line telephone exchange, generally owned in a cooperative arrangement by their subscribers, who are farmers. By means of these telephones scattered families are brought in communication, producers are put in touch with markets and merchants in the towns connected instantly with their sources of supply.

The long-distance lines of the Bell company now extend from Galveston, Tex., to northern Minnesota, and east and west from Maine nearly to Colorado. The past Summer was one of great activity in the building of these lines. Through business over them, between Boston and New York, increased so much last year as to necessitate the construction of a new line of ten wires between the two cities. This line is now being built over a direct route, avoiding larger towns and spanning rivers in order to do away with cables.

In telegraphy very little has been done. The great business of the two large telegraph companies has increased, but has not felt the stimulation given it by the war in the Summer of 1898. In ordinary telegraphy perhaps the most interesting developments were the experiments of a number of newspapers with a method of transmitting drawings by wire. This was a revival of the old method of Caselli and Bain and was fairly successful, so far as the reproduction of the pictures was concerned, but seems to have been abandoned on account of its slowness in working and consequent expense when working on leased wires. An experimental demonstration of the Pollak–Virág system of high-speed telegraphy was made late in the year, and it is stated that its successful operation was well shown.

In the Philippine Islands the United States Army Signal Corps accomplished a feat of great difficulty in maintaining communication with various sections of the Army in northern Luzon. This country is filled with forests of rank growth, bogs and morasses, chains of mountains and other natural difficulties, beside being overrun with the enemy, yet the telegraph wire kept close touch with the different detachments of the Army throughout the Fall campaign. The almost unrecognized work of the military telegraphers deserves the highest commendation.

During the latter half of the year the colliers Brutus and Nero, of the Navy, surveyed a route for a transpacific cable from San Francisco, by way of the Hawaiian Islands and Guam, to a point on the east coast of Luzon in the Philippines. It was found that the route was practicable, though two obstacles, one a mountain rising from deep water to within a few fathoms of the surface, and the other an abyss of hitherto unsounded depth, were found on the great circle course followed and will necessitate divergences.

Wireless telegraphy was exhibited in this country by Mr. Marconi during the international yacht races in October, when successful reports were sent in to a newspaper office in New York by this means. The maximum distance over which it was worked was about 16 miles. On subsequent tests undertaken for the United States Navy, aboard two vessels of the North Atlantic squadron, the trials were not wholly successful and the board of officers under whose supervision the test was made, did not feel, for this and other reasons, able to recommend the adoption of the system in the Navy. Independent experimenting on other systems of space-signaling are now being conducted by both the Army and the Navy.

In other departments of electrical work the advance has been steady and solid, rather than rapid and spectacular. The New Year finds the whole industry in a condition of prosperity and with an almost unparalleled amount of work on hand. Much of this is for export.

During 1899 the export trade in electrical machinery and supplies grew in an amazing fashion. In Great Britain especially was found a market for large shipments of such goods, American firms having secured contracts for several important installations in that country. Our trade with Mexico has also largely extended.

There has not been a time in the 23 years that may be said to fairly comprise the history of the electrical industry in the United States, when the outlook has been brighter or the promise of future prosperity larger than now in the beginning of the last year of the nineteenth century.

QUANTITY DISCHARGES OF ELECTRICITY.

BY PROFESSOR JOHN TROWBRIDGE.

FOR ELECTRICAL REVIEW NEW YEAR DOUBLE NUMBER.

I have been interested lately in studying the effects of discharges of electricity of great quantity, and it seems to me that this subject is perhaps of more scientific interest than that of high electro-motive force, for very high instantaneous states and the earlier experimenters, perhaps, overlooked the manifestations of quantity. A metallic cage, therefore, does not seem a complete protection in all cases for a powder magazine.

The large quantity discharges with which I am experimenting, enable me, as I have said, to obtain high degrees of instantaneous temperature. It is perfectly possible to obtain photographs of the spectra of gases by one discharge through the gases. By the means at my command

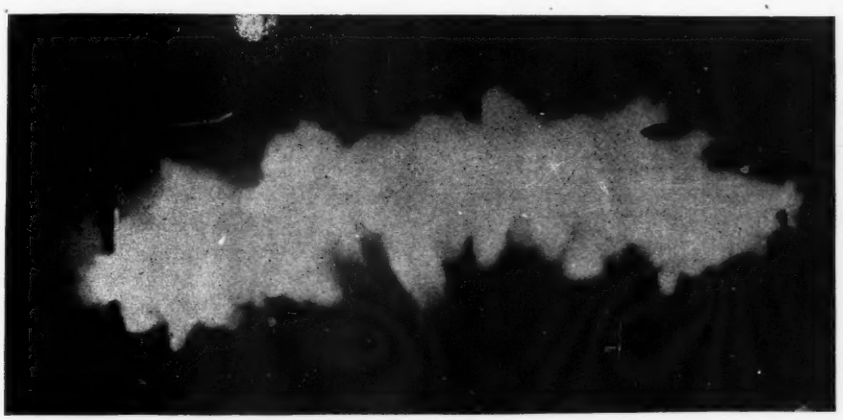


FIG. 1.—QUANTITY DISCHARGES—DEFLAGRATION OF IRON WIRE.

of temperature can be obtained by charging a large coated surface by means of a great number of storage cells, and by suitably discharging them either in air or in rarefied gases.

The accompanying photographs exhibit the discharge of 150 plate-glass condensers, 18 by 20 inches, one-eighth of an inch thick, arranged in multiple and charged to 20,000 volts by means of 10,000 Planté cells. Fig. 1 represents the deflagration of No. 30 iron wire six inches long; Fig. 2, that of the deflagration of a similar length of wire arranged as a shunt to a spark gap. It will be

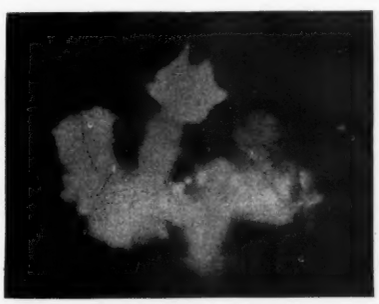


FIG. 2.—QUANTITY DISCHARGES.

noticed that a spark occurs at the spark gap at the same time that the wire is deflagrated. In the case of large quantity discharges of electricity a discharge might occur inside a metallic cage; for the cage may be considered the shunt to a minute spark gap inside the cage. In the case of lightning we undoubtedly have both high electro-motive force and large quantity, a higher degree of instantaneous temperature can be attained than has been hitherto possible—for I shall be able to charge 300 condensers of the above size to 40,000 volts.

A NEW MILITARY TELEPHONE.

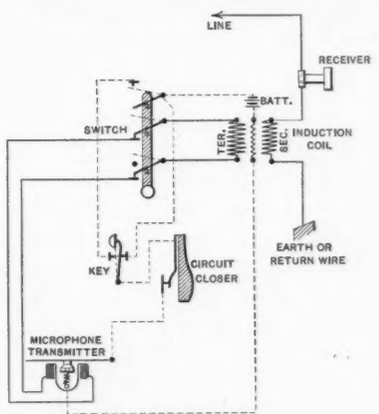
BY CAPT. JOHN P. WISSER, U. S. A.

FOR ELECTRICAL REVIEW NEW YEAR DOUBLE NUMBER.

The telephone has many advantages over the telegraph, but in war the most important conditions to be fulfilled by all pieces of apparatus are facility of transportation and manipulation, and certainty of action, and in these respects the telegraph has undoubted advantages still. However, the immense advantages of the telephone, when it can be used (whether it will ultimately displace the telegraph in war or not), will cause it to be used as long as it will work. Now, if our telephone system gets out of order and we have to unpack and connect a telegraph in its place, much valuable time will be lost, hence Siemens and Halske, the well-known manufacturers of electrical apparatus, have introduced a combined field telephone and telegraph (fully described in *Schweizerische Militärische Blätter*, October, 1899), which may be used at will for phonic or telephonic telegraphy.

The military field telephone is especially important at the outposts of an army in camp, or with the patrols of the advance guard on the march, and to meet the requirements of its application there, it must be strong, simple in construction, light and reliable, and the elements of the battery used with it must be strong, durable and chemically stable. The first three conditions (strength, simplicity and lightness) can be readily combined, but all previous methods of obtaining also a reliable call arrangement have too greatly increased the size and weight of the whole. This difficulty the new apparatus appears to have overcome.

The entire outfit comprises a wooden battery chest and a leather telephone case, the whole weighing about nine pounds. The microphone (which is very sensitive, can be used in any position, and emits clear tones) is connected with the receiver through a cylinder containing the switch, the circuit closer and the key; and connection with the battery chest (which contains the battery and induction coil) is affected by means of a wire of several strands, contact being made by inserting a contact pin. The battery is composed of two dry cells (electro-motive force 1.5 volts, resistance 0.8 ohms). The connections at a single station are indicated in the diagram, the full lines showing the switch and key in the position of "calling or telegraphing," the dotted lines when "telephoning or speaking." In the first case, by depressing key and circuit closer the primary circuit is made, and a current is induced in the tertiary wire, which by weakening the permanent magnet in the microphone causes the diaphragm to move out. But this motion causes the bag of granulated carbon to be elongated, thus (by diminishing the diameter of this



A NEW MILITARY TELEPHONE.

conductor) increasing the resistance, causing diminution of primary current and a consequent reverse current in the tertiary wire; by this reverse current the diaphragm is made to move in, which bulges out the carbon bag, diminishing the resistance, and so on. These induced currents, repeated in the secondary wire, cause a distinctly audible humming sound both in our own telephone receiver and in that of the corresponding station. In the second case (practically affected by simply moving a button on the cylinder which brings the switch to the proper position, and letting go the key) the electro-magnet is cut out, and we have merely an ordinary telephone circuit, the microphone becoming the transmitter.

Aside from the intrinsic qualities of this instrument, it possesses, as a field apparatus, the great advantage of enabling the operator to pass readily from telephone to telegraph.

THE COMPOUNDING OF HARMONIC VIBRATIONS WITH FIXED PHASE DIFFERENCES.

BY PROFESSOR WILLIAM HALLOCK.

For Electrical Review New Year Double Number.

A question very interesting, as well to the psychologist as to the physicist, is whether the ear takes cognizance of phase differences in the tone complex which it hears.

Of course where the tones are of the same frequency the resultant is also a simple harmonic motion of the same frequency, and the phase difference of the components affects only the amplitude of the resultant, as for example, curve A compounded of I and II, Fig. 2.

If, however, a tone and its octave are combined we get analytically very different curves, B and C, according to the phase difference of the components. It seems incredible that a motion of the ear drum represented by a curve like C should produce the same tone sensation as one represented by B, and yet experimental evidence so far points to the identity of the tone quality in the two cases.

I have always had a feeling, however, that the experiments were unsatisfactory, and that, although the phase difference was present at the start, the motion represents a state of unstable equilibrium, and the two waves will each yield a little and drop into step. It is even conceivable that the more agreeable effect of an orchestra at a distance is partly due to the fact that space and opportunity has been offered for the tones to get into step. Incidentally the results of settling this point may be of interest in telephony and possibly in other alternate-current work.

There are several ways in which the problem may be attacked, and pending my completion of an apparatus for the complete and final settlement of the question by another method, it seemed worth while to try a few preliminary tests, and

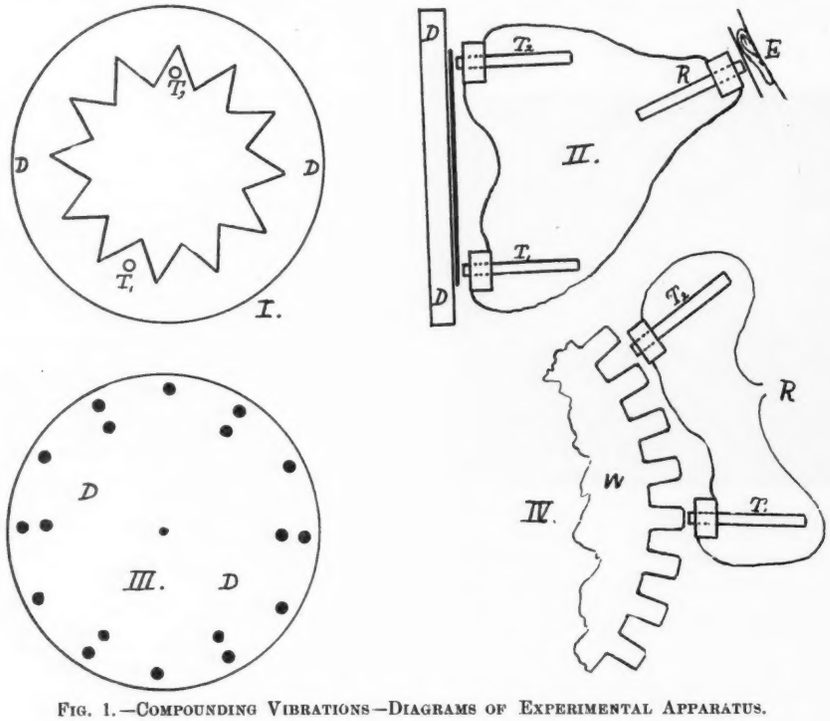


Fig. 1.—Compounding Vibrations—Diagrams of Experimental Apparatus.

Two telephones, T_1 and T_2, were supported as shown in I and II. They were connected in series with each other and with a receiver R. T_2 was stationary, but T_1 could be moved toward the centre and away from it and also around it. Of course the iron points passing in front of T_1 and T_2 induce electric waves whose frequency depends upon the rate of rotation of D, and whose intensity depends upon the proximity of T_1 and T_2 to the metal points. Hence the wave due to T_1 must have absolutely the same length as that due to T_2, and their relative intensities can be varied by moving nearer to or further from the disk. By changing the angular relation of T_1 with reference to T_2 any phase difference between the two wave series can be brought about.

Although the experiment was rather crudely carried out, still it bore out the theory. The phase difference affected only the intensity, and neither the pitch nor quality.

The same experiment was tried by putting iron pegs into the wooden wheel D, as in III. The results were more satisfactory than with the star wheel. Probably the best would be an iron cog-wheel as in IV.

Neither I nor III gave a sine wave or simple tone. Undoubtedly a tooth of special shape in IV would approximately give a sine wave, and much less noise than I and III.

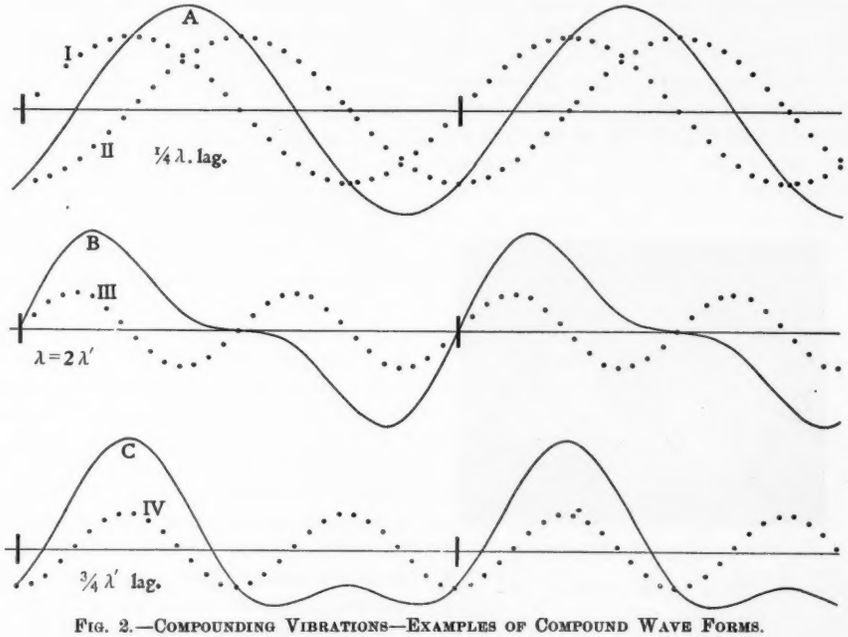


Fig. 2.—Compounding Vibrations—Examples of Compound Wave Forms.

A pointed disk of so-called "roofing tin" was so mounted on a wooden wheel, D D, that it could be rotated at varying speeds. Fig. 1, I and II.

An attempt was made with III to combine a tone and its octave with phase differences by means of two rows of iron pegs. There was, however, too much noise in the sound, and it was impossible to arrive at any definite conclusions. Dr.

F. L. Tufts very kindly made the apparatus and repeated the experiments.

I have under construction a set of cog-wheels, with teeth in the proportion of 1, 2, 3, 4, 5, 6, 7, 8, whereby I can combine a tone with its first seven overtones, varying their relative intensities and phases if necessary.

The great merit of this line of work is that the electric waves generated must hold their phase relations, and there is no chance anywhere for the two harmonic motions to change their relation before they reach the inner ear. Some interesting questions in the psychology of hearing are involved in this problem.

The above apparatus could be modified in various ways and promises to be useful for several different lines of investigation.

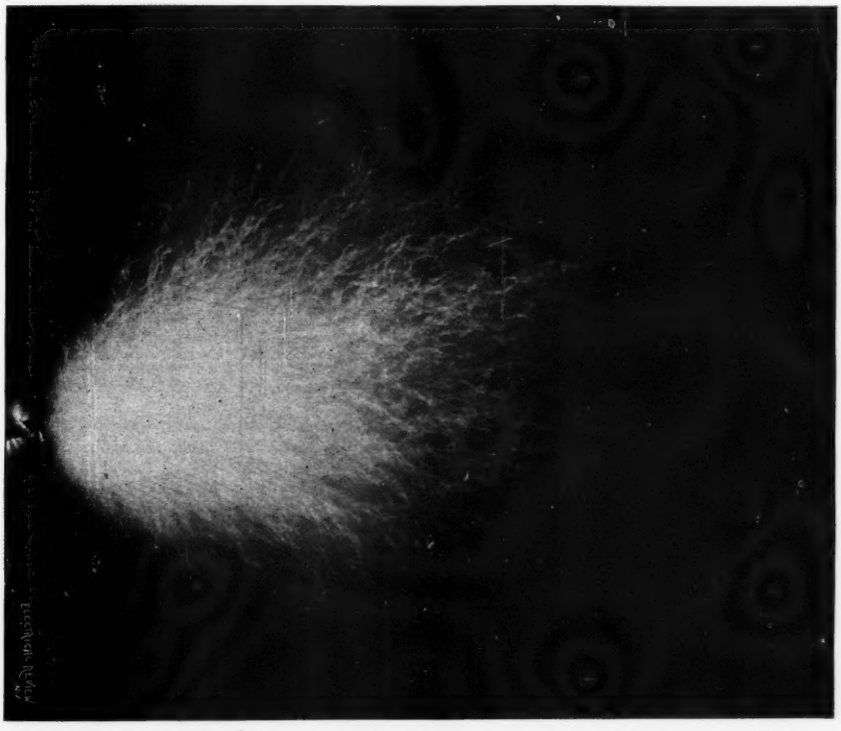
A DURABLE FORM OF THE WEHNELT INTERRUPTER.

BY R. H. CUNNINGHAM, M. D.
FOR ELECTRICAL REVIEW NEW YEAR DOUBLE NUMBER.

If many of your readers have had occasion to use Professor Wehnelt's ingenious instrument in its original form, doubtless their experience with it has been similar to my own; namely, that after a few minutes usage the glass tube bearing the platinum wire breaks at the seal and the instrument is useless. In the improved forms in which the glass tube is replaced by one of hard rubber, or of porcelain, the durability is greater, but at most not very great if the instrument is subjected to frequent use. The hard rubber is rapidly worn away around the platinum wire, so that after a few hours' usage the acid electrolyte begins to attack the brass or copper rod bearing the platinum. The porcelain is worn away less rapidly, but often cracks, a mishap that is often followed by the blowing off of the lower end of the tube. From various published accounts the commercial form of the apparatus, such as has been depicted often in various German and American technical journals, seems also very liable to the above-mentioned mishaps, and to repair some of the foreign forms is often a matter of considerable difficulty.

To minimize the occurrence of such accidents and to make the apparatus more suitable for prolonged use with both light and heavy currents, I have employed for some months the following form of apparatus: The acid electrolyte is contained in a hard-rubber cell, with a tight-fitting top that is perforated for the insertion of the anode and for the two ends of the coil of small lead pipe that forms the cathode. A short tube of hard rubber is screwed into the top, and through this the fumes escape *via* a flexible rubber tube into a jar containing a number of sponges moistened with a strong solution of washing soda. By syphoning water through the lead pipe any desired temperature of the electrolyte can be maintained for hours. The adjustable anode is made of a brass rod threaded with a long thread at the upper end for the adjusting thumb-nut, and into the lower end the requisite sized platinum wire is brazed with silver solder. After thoroughly coating this rod with some thick unguent—for instance, with vaseline—it is inserted into a thick-walled, closely fitting, hard-rubber tube that has a *lava* bushing firmly screwed and cemented into its lower end with some acid-proof, non-conducting cement. The hole through this bushing should be smooth, and the platinum wire should fit snugly. If a thick platinum wire (No. 6 or No. 8) is used this form of the interrupter is capable of passing heavy currents without the least danger of breaking down.

To illustrate one of the effects readily produced from the 115-volt continuous current with this instrument when used in conjunction with a crude, home-made high-frequency apparatus, I append the accompanying photograph of a brush discharge from the ball terminal of the high-frequency coil. The brass ball is two inches in diameter, and some of the streamers from it apparently have a radius of about three feet.



"A DURABLE FORM OF THE WEHNELT INTERRUPTER"—BRUSH DISCHARGE FROM BALL TERMINAL OF HIGH-FREQUENCY COIL.

Electric Fire Engines.

It is stated that electric fire engines are soon to be built by a company recently chartered for that purpose in Des Moines, Iowa. Electricity instead of steam is about the only difference between the engines the company proposes to manufacture and those already on the market. It is also claimed for the new device that it can be made a great deal less expensive, both in its manufacture and employment. Steam stationary boilers, as are used in the present engines, will be done away with. At any street corner it is claimed that a connection can be made with a street-car trolley wire or an electric light main, and power secured immediately.

The number of inquiries arriving from Porto Rico indicates that there is a general improvement of trade in the island. The orders arriving for provisions are beginning to show evidence of prosperity. In the manufactured line, however, the call is yet below the average, but this is due, it is said, to the season of the year. It is generally expected that early in 1900 a much heavier demand will exist for agricultural implements and manufactured iron. If the many improvements and developments expected to be made by the large number of Americans who are fast invading the island materialize, in a year's time San Juan, Ponce and Mayaguez may be called modern towns. The opportunities that will shortly exist in Porto Rico for trade in electrical apparatus, building material and general hardware are such as to warrant the early attention of those who may care to be the first in the field.

THE ENERGY OF TELEPHONE CURRENTS.

BY EUGENE W. CALDWELL.

For Electrical Review New Year Double Number.

In long-distance telephony, in telephoning without wires and in the almost forgotten field of the loud-speaking telephone, it is necessary to produce currents which shall not only represent accurately the sound waves to be reproduced, but which shall have considerable power.

We are accustomed to think that the distance over which telephonic communication is possible is not limited by the energy of the transmitter current, but by the properties of the line, which tend to distort the current waves and to impair the accuracy of transmission.

The so-called "telephonic properties" of a long line can be very much improved by connecting high-resistance leaks across it at frequent intervals; but, if this is done, only a small fraction of the current delivered by the transmitter may be received at the distant end of the line.

However, if we could produce sufficiently powerful telephone currents it would not be difficult to design lines of this kind, which, although very wasteful of energy, would allow telephonic transmission over much greater distances than are now considered possible.

If we had telephone transmitters of sufficient power it would be easy to establish telephone communication between the ships of a fleet or between lightships and the shore without the use of line wires. This could be done either by diffusing the telephone current through the water or the earth, or by using some of the induction methods that have been proposed.

It is not improbable that with telephone currents of greater energy and greater accuracy the musical telephones of Mr. Edward Bellamy's "Looking Backward" might become a poetical reality.

Since the energy of the current delivered by a telephone transmitter is derived from a battery and not from the sound waves, it may seem possible, by using stronger batteries and larger transmitters, to obtain very powerful telephonic currents. It is found in practice, however, that increasing the size and mass of the vibrating parts of a transmitter results in impairing the accuracy of transmission, and, with a carbon transmitter, increasing the strength of the battery current beyond a certain limit heats the carbon contacts, lowers their resistance and reduces the output of the instrument. It has therefore been impossible, so far, to make a satisfactory telephone transmitter of very much greater power than those now in common use.

It is not easy to measure the strength of a telephone current, and comparatively little has been published on the subject. The experiments described below were made some time ago by Professor Blake, and the writer, in order to determine under what conditions of battery, induction coil, and adjustment of contacts a transmitter would give the best results; and, incidentally, to measure approximately the energy represented by the strongest telephone currents we could produce.

At first it was attempted to measure the output of the transmitter by passing the current through a non-inductive resistance which formed a part of a small calorimeter, and measuring the rise of temperature. This method, as may be supposed, was slow and unsatisfactory.

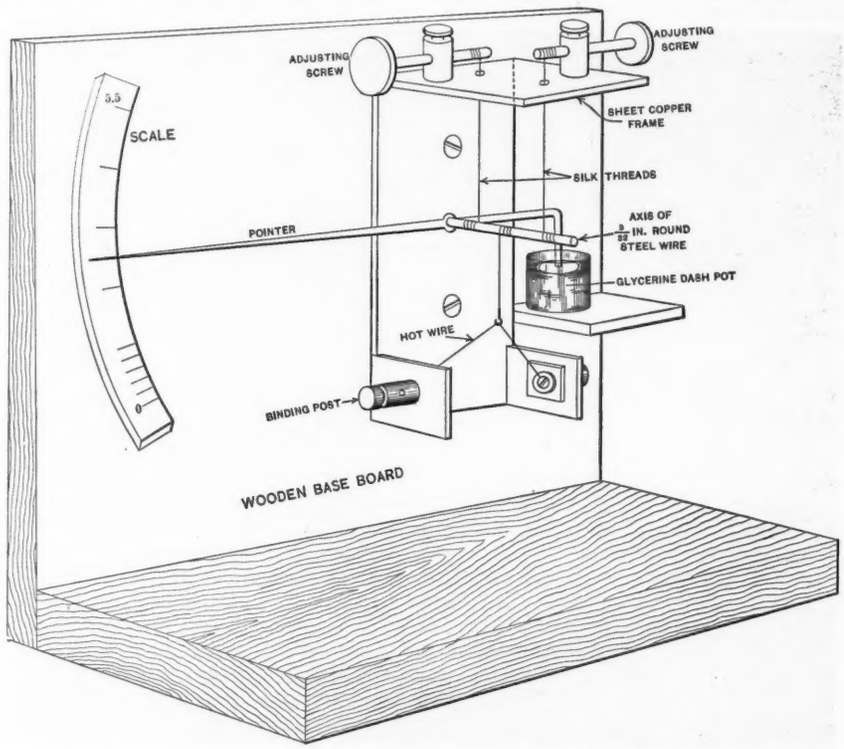


Fig. 1. The Energy of Telephone Currents—The Hot-Wire Ammeter.

In Fig. 1 is shown a "hot-wire" ammeter which was designed to absorb the greater part of the energy of the transmitter and to measure the strength of the telephone current. The current to be measured is passed through a thin wire which is held in a horizontal position between two clamps about six inches apart. The middle of this wire is connected by a small hook and a silk thread with the axis of a long light pointer which moves over a scale and thus indicates the expansion of the wire. A dash-pot is provided to steady the movements of the needle. The instrument is so constructed that wires of various sizes, according to the current to be measured, can easily be inserted in the clamps. Before and after each experiment the meter was carefully calibrated with a direct-current and a standard Weston ammeter. As would be expected the scale divisions increased in size nearly according to the square of the current. With a No. 31 copper wire a current as small as one-quarter ampere could be read with fair accuracy, and five amperes deflected the needle about six inches.

The energy of the telephone currents was computed from the resistance of the meter and connections and the current strength. Several kinds of transmitters were tried, but in the experiments described here a granular carbon transmitter of the "solid back" type was used.

Induction coils of different sizes and winding were tried, and some of them were tapped at numerous points so that the number of turns in primary or secondary could be changed quickly and the result upon the ammeter noted. One of the best induction coils used had 250 turns of No. 16 B. & S. wire in the primary and 40 turns of No. 7 B. & S. wire in the secondary. The core was 9 inches long and contained 14 ounces of annealed iron wire.

The transmitter was actuated by an organ pipe or by singing or talking into it. A telephone receiver was arranged to be temporarily connected in the secondary circuit of the transmitter in order to test the quality of the telephone currents and to guard against making the transmitter rattle by speaking too loud.

A Weston direct-current ammeter was arranged to be temporarily inserted in the

battery circuit in order to find out what current strength would give the best results in the transmitter. It was found that the greatest output was obtained when the ammeter in the battery circuit registered about 2½ amperes.

This current strength was obtained with an electro-motive force of about 7 volts, the internal resistance of the battery being about 0.15 ohm. If while singing into the transmitter the strength of the battery was either increased or diminished, the hot-wire ammeter immediately indicated a smaller current in the secondary circuit.

The winding of the secondary of the inductive coil and the resistance of the hot-wire meter circuit were adjusted with reference to each other so as to obtain the greatest output. It was found, however, that the energy of the telephone current was fairly constant with considerable range in the resistance of the circuit. For example, while singing a continuous tone into the transmitter the resistance of the secondary circuit was suddenly changed from 0.26 ohm to 0.06 ohm. The current increased from 2 amperes to 4.2 amperes, but the output in each case was almost exactly 1 watt. In another experiment the output was 1.06 watts with 0.06 ohm resistance, and 1.25 watts with 0.16 ohm in the meter circuit. With a resistance of 0.66 ohm in the circuit the output was reduced to 0.14 watt, but it immediately jumped to 0.74 watt when the resistance was changed to 0.06 ohm.

In Fig. 3 the transmitter is shown connected with an induction coil similar to the one above described but with a secondary winding of about 1,100 turns of No. 26 wire. The secondary was connected through a five-mile circuit with a ring transformer, and the short winding of the transformer was connected to the hot-wire meter. With this arrangement it was not difficult to obtain a good telephonic current, representing one to one and one-half watts.

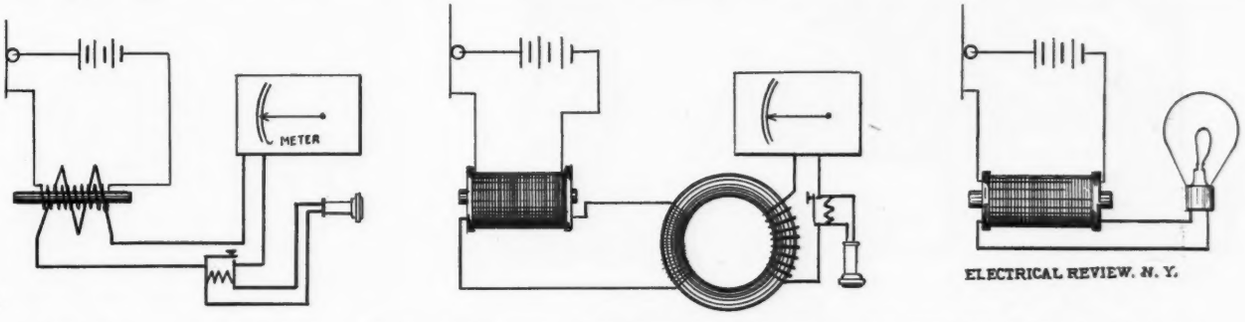
Fig. 4 shows the secondary of the transmitter connected with a 1.2-volt miniature lamp. It was found that this lamp could easily be lighted by talking or singing into the transmitter.

The strength of a telephone current varies, of course, with the loudness of the voice actuating the transmitter. When words are spoken into a transmitter it is obvious that the energy of the current is rapidly changing from zero to the maximum, according to the syllables spoken.

Most of these experiments were made by singing a continuous note into the transmitter, and the measurements obtained probably represent the maximum value reached by the telephone current at any instant of a conversation.

The strongest telephone current produced with the carbon transmitter was five and one-half amperes, and this was obtained with a resistance of 0.05 ohm in the meter and connections. The maximum output obtained from the transmitter was 2.25 watts—*i. e.*, five amperes through a resistance of 0.09 ohm. When it is considered that such a current is equivalent to 0.003 horse-power, or about 100 foot-pounds per minute, it will be apparent that, even with the transmitter now in use, it is possible to produce telephone currents of considerable power.

The measurements mentioned above were made under conditions favorable for obtaining powerful currents. Similar experiments under conditions more nearly approaching those of every-day practice indicate that the maximum instantaneous value of the energy of an ordinary telephone current probably reaches one-quarter watt or more.



FIGS. 2, 3 AND 4.—THE ENERGY OF TELEPHONE CIRCUITS. DIFFERENT ARRANGEMENTS OF TRANSMITTERS, INDUCTION COILS AND TRANSLATING DEVICES.

American Institute of Electrical Engineers.

The 138th meeting of the Institute was held at 12 West Thirty-first street on December 27, President Kennelly in the chair, about sixty members and guests being present. A communication by H. H. Wait, of Chicago, was read by Mr. Albright on "The Cost of Arc Lighting," being in discussion of Professor Robb's paper presented September 27.

A paper was also read by Capt. Geo. O. Squier on "An American Pacific Cable," which was illustrated by lantern slides. The discussion was opened by Mr. Herbert Laws Webb and participated in by Messrs. Hallberg, Hughes, Kennelly and Pupin.

At the meeting of the Executive Committee in the afternoon the following associate members were elected:

Carl Earnest Hardy, student, Cornell University; residence, 306 Huestis street, Ithaca, N. Y.; Homer M. Jaquays, lecturer in mechanical engineering, McGill University; residence, 862 Sherbooke street, Montreal, Que.; Seizo Misaki, chief engineer and superintendent, Hanshin Electric Railroad Company, Front Sannomiyo Station, Kobe, Japan; Virginius Daniel Moody, senior student, Cornell University; residence, 215 Dryden road, Ithaca, N. Y.; Jeremy F. Taylor, electrician, Detroit Copper Company, Morenci, Ariz.; Frank A. Wolff, Jr., professor of physics and electrical engineering, Corcoran Scientfiic School, Columbian University and in office United States standard weights and measures, Washington, D. C.

The following associate members were transferred to membership:

Ernest Holcombe Hewlett, electrical engineer in chief control, Rockhampton Gas and Coke Company, Ltd.; residence, Estoril, Rockhampton, Queensland, Australia; Chas. Edwin Knox, with C. O. Mailoux, consulting electrical engineer, 150 Nassau street, New York; Wm. Corwin Burton, with J. G. White & Company, 29 Broadway, New York city.

The Number of Incandescent Lamps in Use.

TO THE EDITOR OF ELECTRICAL REVIEW:

In your December 13 1899, issue, you published a statement regarding incandescent lamps that we can not let pass without a correction.

The statement that there are over 60,000,000 incandescent lamps used each year is at least three times too large, the consumption of incandescent lamps in this country not exceeding 20,000,000 per annum. There is not a city in this country that uses 3,000,000 lamps per year. The largest city is New York, and the consumption is about 2,000,000, including central stations, isolated plants and railways. F. W. WILLCOX.

Harrison, N. J., December 28, 1899.

THE ELECTRICAL COLLECTIONS IN THE SMITHSONIAN INSTITUTION AND THE NATIONAL MUSEUM—I.

BY GEO. C. MAYNARD.

THE SMITHSONIAN INSTITUTION.

Located in the centre of the city of Washington, half-way between the Capitol and the Executive Mansion, in a beautiful park of fifty-two acres, is a building, Norman-Gothic in architectural design, and built

THE NATIONAL MUSEUM BUILDING, WASHINGTON, D. C.

of rich, dark brown stone quarried on the banks of the Potomac River, a few miles away, which has no counterpart anywhere; its single, steadfast purpose is the increase and diffusion of knowledge throughout the world. The structure was designed by architect James Renwick, Jr., and the corner-stone was laid May 1, 1847. Portions of the building were occupied in 1849, and it was finally completed in 1855.

The name of the Smithsonian Institution is familiar to every one, and its history has often been told. The briefest outline will suffice as an introduction to an account of some features of its work in electrical departments and of the electrical objects on exhibition in its collections. The founder was born in France, educated in England, spent many years in European countries, and died in Italy—a man without a country or a home. His father was the Duke of Northumberland; his mother was Mrs. Macie, a descendant of the Duke of Somerset and of Henry VII. For the first thirty-seven years of his life he was called James Lewis Macie; after that period he asserted his undeniable right to the name of James Smithson. He was never married. Shrinking from the impending fate of oblivion to which the social customs and accidents of the Old World were consigning him, he turned to the New World, as the only fitting place for a monument whose purpose should be, not to perpetuate his fame, but to benefit all mankind. To the establishment of such a monument he devoted his entire fortune and charged the government of the United States with the duty of carrying out his wishes. On August 28, 1838, the packet ship Mediator brought to this country one hundred and five bags of English sovereigns which, converted into United States coin, amounted to the sum of $508,318.46. This amount was subsequently increased by additional receipts from the Smithson estate and from other sources, and the annual income from the Smithsonian fund is now about sixty thousand dollars. Besides this, regular appropriations for special objects are made by Congress.

THE SMITHSONIAN BUILDING, WASHINGTON, D. C.

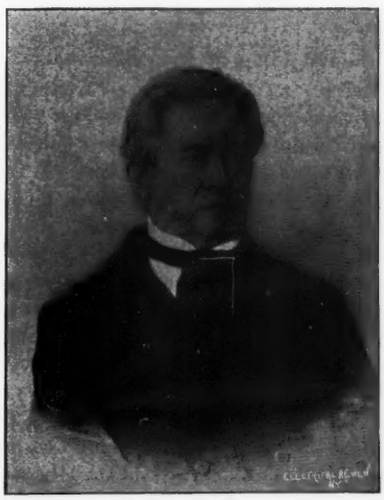
The Institution was organized in 1846. It has been singularly fortunate in keeping free from political influences and in having experienced few changes in administration. During its existence of more than half a century it has had but three secretaries, and the promotion of its objects has been the life-work of these officials. Henry, the high-minded, gentle, profound philosopher; Baird, a physical and intellectual giant, distinguished naturalist and practical man of affairs; Langley, mathematician, astronomer, physicist, a bold, dauntless and successful explorer in unknown realms of science; masters of their calling, every one.

Joseph Henry, born in Albany, N. Y., December 17, 1799, was chosen as the first secretary on December 3, 1846, and remained at the head of the institution up to the day of his death, May 13, 1878. His successor, Spencer F. Baird, was born in Reading, Pa., February 3, 1823, appointed May 17, 1878, and died August 19, 1887. He had served as assistant secretary for twenty-eight years before his election to the higher office. Samuel Pierpont Langley, the third secretary and present chief executive officer of the Institution, was born in Roxbury, Mass., August 22, 1834, and was elected to succeed Professor Baird, November 18, 1887.

The governing body of the Institution is a board of regents, composed of the Vice-President of the United States, the Chief Justice of the Supreme Court, three Senators, three members of the House of Representatives and six citizens. The board has an executive committee of three members, closely associated with the secretary in the management of affairs. Gardiner G. Hubbard was a member of the executive committee for several years, and after his death Alexander Graham Bell was chosen to take his place.

Almost every branch of science is represented in the permanent staff of the Insti-

tution by eminent investigators and students, who are constantly at work in their respective departments, while the active cooperation of officials in all branches of the government is freely given. A large number of scientific men, foremost in their professions, voluntarily and without compensation, give most valuable service in promoting the objects of the Institution. Every officer of the army and navy, wherever stationed, is a collector, both of information and of interesting objects. There are agents and correspondents in every part of the world,



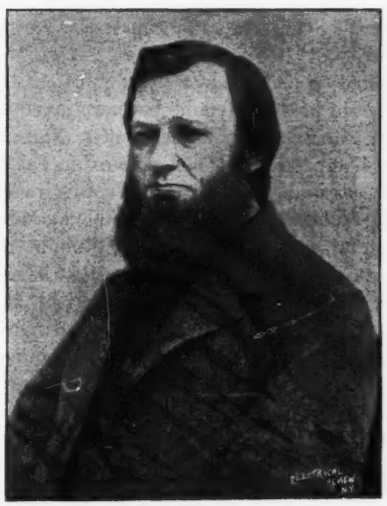
JOSEPH HENRY, FIRST SECRETARY OF THE SMITHSONIAN.

including foreign governments, universities, libraries and persons in public and private life. The number of these runs into thousands and through them the Smithsonian keeps in touch with the whole world. Through a system of international exchanges it distributes not only its own publications, but a certain number of every publication issued by the government, and receives a great mass of valuable scientific literature, the most of which is deposited in the new national library. Once every year a volume is issued made up largely of the most important papers on current topics taken from other publications. During the last few years the following papers on electrical subjects have been published: The Present Status of the Transmission and Distribution of Electrical Energy, by Dr. Louis Duncan; The Utilization of Niagara, by Thomas C. Martin, and Electrical Advance in the Past Ten Years, by Professor Elihu Thomson. Other papers now in press are The Development of Electrical Science, by Professor Thomas Gray; Telegraphing Across Space, by S. P. Thompson, and Signaling Through Space Without Wires, by W. H. Preece.

Mr. Richard Rathbun is the assistant secretary, and when Dr. Langley is absent has full charge of the affairs of the Smithsonian and the National Museum.

THE ASTROPHYSICAL OBSERVATORY.

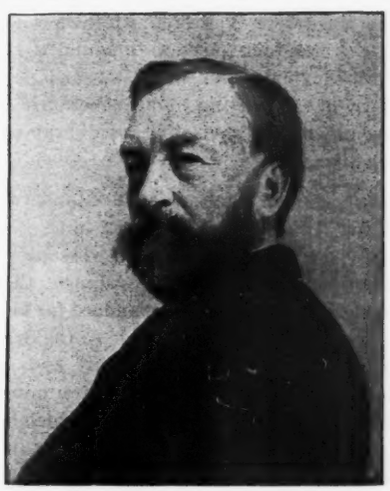
This is one of the most important departments under the control of the Smithsonian. It occupies a small, one-story, wooden building in the Smithsonian grounds and is equipped with apparatus which, for delicacy and accuracy, would astonish the majority of electricians. This observatory is under the immediate personal control of Professor Langley, who may be said to have created it. As explained by him, "the distinct object of astro-physics is, in the case of the sun, for example, not to mark its place in the sky, but to find out how it affects the earth and the wants of man on it; how its heat is distributed, and how it in fact affects not only the seasons and the farmer's crops, but the whole system of living things on the earth, for it has been



SPENCER F. BAIRD, SECOND SECRETARY OF THE SMITHSONIAN.

proven that in a physical sense it, and almost it alone, literally first creates and then modifies them in almost every possible way." The principal part of the work now being carried on in the observatory is the measurement of the temperature of the invisible portion of the solar spectrum by means of the bolometer, an instrument invented by Professor Langley in 1881 and which he has much improved since that time. This is a modification of Wheatstone's bridge, of most extraordinary sensitiveness. Two arms of the bridge are made of fine strips of platinum, thinner than a human hair, and it is so delicately contrived that, when passed through the invisible spectrum, a change in temperature of less than the millionth part of a degree is readily indicated. The current of electricity passing through the bridge is carried to a Thomson reflecting galvanometer, which is quite as sensitive as the bolometer. This apparatus was also designed and constructed by Professor Langley and his assistants. The weight of the needle and mirror in this galvanometer is two and five-tenths milligrammes, and the quartz fibre by which it is suspended is thirty centimetres long and .0015 millimetre in diameter. The current required to give a deflection sufficient for practical work, with a resistance of thirty ohms in the galvanometer coils, is five trillionths of an ampere. The movements of the needle are photographically recorded, and the operation of the whole system of apparatus is automatic. The most careful and perfect precautions are taken to shield the instruments from all outside influences. The results of the observations and researches can not fail to be of immense practical value.

The National Museum, although legally a separate institution, is under the control of the secretary of the Smithsonian, and, so far as the general public is concerned, the two establishments may be regarded as one. The Museum building must be classed among the things that are "useful but not ornamental." It stands just eastward from the Smithsonian, and was built in 1880–81. It was first opened to the public March 4, 1881, when it was used as



S. P. LANGLEY, THIRD SECRETARY OF THE SMITHSONIAN.

a reception hall at the inauguration of President Garfield. It is 300 feet square, and is well adapted to the exhibition of the extensive collections with which it is filled. The public is admitted every week day, and in the last ten years more than four millions of visitors have entered its doors. Its interior arrangements form an open book, whose pages any one may read at pleasure, and competent translators are always at hand to explain doubtful paragraphs. A noticeable class of visitors consists of groups of students from all parts of the country and from all grades of schools, from the kindergarten to the highest university.

SCIENCE BREVITIES.

The Preservation of Timber—In a lecture delivered recently by Mr. E. J. Silcock, before the Yorkshire College Engineering Society on "Creosoting Timber," he described in detail the treatment required by telegraph poles for their preservation. Decay in timber is brought about in three ways—by the action of bacteria in the albumen in the sap; by the absorption of water, and by the action of insects. It is calculated that an ordinary fir telegraph pole, without any chemical preparation, will become rotten in seven years. In 1848, 318 creosoted poles were erected between Fareham and Portsmouth, England. In 1861 they were examined, and only two showed the slightest trace of decay, and these were replaced. In 1883 the poles were still in use, and apparently were quite sound. In 1861 forty miles of poles were planted between Yeovil and Exeter. By way of an experiment they were arranged in threes, the first in each trio being a plain pole, the second one had been Boucherised, and the third had undergone the creosoting process. In 1870 all the plain poles had been removed, 30 per cent of the Boucherised poles were exhausted, while the whole of the creosoted poles were sound. The author explained in detail various processes of creosoting, and concluded by recommending creosoting as a cheap and effective process of preserving timber.

A Practical Thermometric Standard—Mr. H. L. Callendar advances, in a recent paper, an imposing array of reasons for adopting the platinum-resistance thermometer as the practical standard for high temperatures. The preamble to the draft proposals submitted to the British Association at Dover, and provisionally adopted, states that the gas thermometer, which has long been adopted as the theoretical standard, has given results so discordant in the hands of different observers at high temperatures as greatly to retard the progress of research. The author further adds that the backward state of the science of heat at the present time, our comparative ignorance of the fundamental laws of radiation and dissociation, and of many other phenomena as dependent upon temperature, are principally due to discrepancies of gas thermometry. The platinum-resistance thermometer has distinct advantages over the thermo-couple, on account of its greater accuracy and simplicity, says an *Electrician* abstract. It is sufficient to send a few grammes of the standard wire in an ordinary letter to reproduce the scale with the utmost accuracy in any part of the world. The author deals at length with the selection of the platinum sample and the standardization of the instrument. The latter must, of course, be based ultimately upon the gas thermometer.

Zinc Oxide Reduction—Some interesting experiments on the reductions of zinc oxide under pressure were recently made at the Royal Polytechnic School, Berlin, by Dr. R. C. Schüpphaus and Dr. E. E. Lungwitz. The apparatus used was heated electrically, and consisted of an outer vessel of cast-iron, lined thickly inside with blocks of fireclay, a space in the centre of these blocks being reserved to receive a crucible; surrounding the crucible was a cylinder of fireclay, over which a fine platinum wire was strung. A current passed through this wire provided the required source of heat, while the temperature attained could be measured by means of an electric pyrometer. The cast-iron containing vessel was provided with a cover, which was bolted on and made a tight joint. Any desired pressure could be maintained inside the crucible by means of a Natterer air-compressor. When zinc oxide was reduced under pressure inside this vessel, the sublimation of the metal was prevented, and it collected as a fluid at the bottom of the crucible, and could be cast in ingots. Similarly, commercial zinc dust was easily fused and cast into ingots. Apparently, moreover, the experimentalists succeeded in producing a lower oxide of zinc, which is quite stable at ordinary temperatures, and is of a yellow color.

X-Rays in Archæological Work—Shortly after the announcement of the discovery of the Roentgen rays, Prof. Stewart Culin, of the Free Museum of Science and Art of the University of Pennsylvania, foresaw the possible future of the new rays in examining the internal construction of valuable museum specimens. After suitable apparatus had been installed in the Pepper Clinical Laboratory by Dr. Charles Lester Leonard, an attempt was made to test the practical application of its value in archæological work, says the *Scientific American*. Dr. Leonard made a successful radiograph of a Peruvian mummy, and the photograph disclosed the fact that the closely wrapped bundle contained the skeleton of a child having a string of stones or shell beads about its neck. Another radiograph was obtained of a desiccated human foot with a leather sandal. This gave promise of the utility of such pictures in the examination of such objects. Mr. Cushing expressed the opinion to Professor Culin that a piece of turquoise was concealed beneath the heavy wrapping of brown yarn that binds the finger loops of every fine prehistoric throwing stick from Mancos Cañon, Col., in the University museum. It occurred to Professor Culin that the verification of this conjecture might be secured, and photographs of the wrappings with corresponding radiographs were made, with the result that four stone beads, presumably of turquoise, were revealed as Mr. Cushing had surmised. The extreme fragility of the wrapping was such as to render an examination by other means impossible without serious injury to a most valuable specimen.

The Properties of Some New Alloys—At a recent meeting of the Birmingham Scientific Society, an address on "The Properties of Some Alloys" was delivered by Mr. Alexander E. Tucker. At the outset he pointed out instances of change in alloys due to external action and internal causes, and described a nickel aluminum alloy containing some four per cent of nickel, which, in a few hours after being cast, fell to powder at ordinary temperatures, an extraordinary result when the toughness and malleability of the separate metals was regarded. The effect of bismuth on copper and brass was also referred to, and he said that the matter might be summed up in a general statement that, given the properties of a definite alloy, the effects of introducing even a trace of a foreign substance into it could not be foretold by any reasoning from analogy. The past masters of metallurgical art, the Japanese, had only reached their skill by generations of intelligent plodding, and often baffled us, with all our science, in the discovery of their methods. He alluded to the application of metallic aluminum as a means of producing the rarer metals in a pure form, which process seemed likely to replace the more complex apparatus of the electric furnace. Steel has recently been produced by melting hematite pig with steel scrap, and adding to the natural hardness of the mixture so obtained by a judicious addition of manganese-tungsten alloy, the solidity of the ingots being insured by adding aluminum nickel. The steel produced by that method did not lose its hardness by heating during use, and was said to be equal to that of ordinary "self-hardening" steel. The author said that it would be apparent, bearing in mind the number of metals at present at practical disposal, that an infinite field of research is open, and one in which the reward to the worker is great. The amazing variation of properties caused by a slight change in alloy composition has long been known, and as the number of metals available for alloying steel are large the possible combinations are practicably infinite.

Central Station Fire in New York City.

One of the most disastrous fires of recent years in New York city occurred on the night of December 29, when a large wall-paper factory on East Twenty-fourth street was completely destroyed. Adjoining the factory was a station of the Manhattan Electric Light Company, which is owned by the Edison Electric Illuminating Company of New York city. This was the old East River Electric Light Company's plant, and it also was completely destroyed. The loss is now being adjusted. The station was known as the Madison Square station and supplied between 700 and 800 arc lights for street and commercial use and from 900 to 1,000 kilowatts of alternating current for other purposes. The Manhattan Electric Light Company by Saturday night had all its connections made to other mains, so that customers were not interrupted in their service. The station will not be rebuilt.

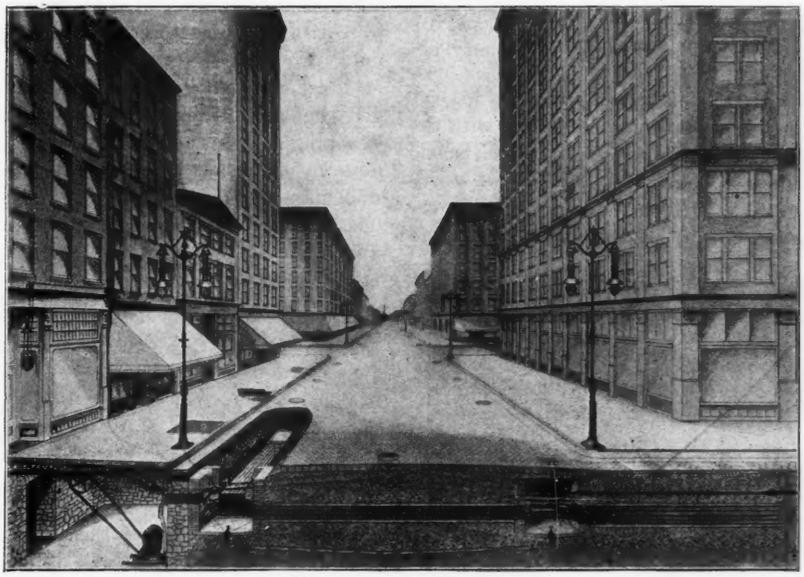


FIG. 1. TYPICAL SECTIONAL VIEW OF A PART OF THE ROCHESTER, N. Y., GAS AND ELECTRIC COMPANY'S SUBWAY SYSTEM.

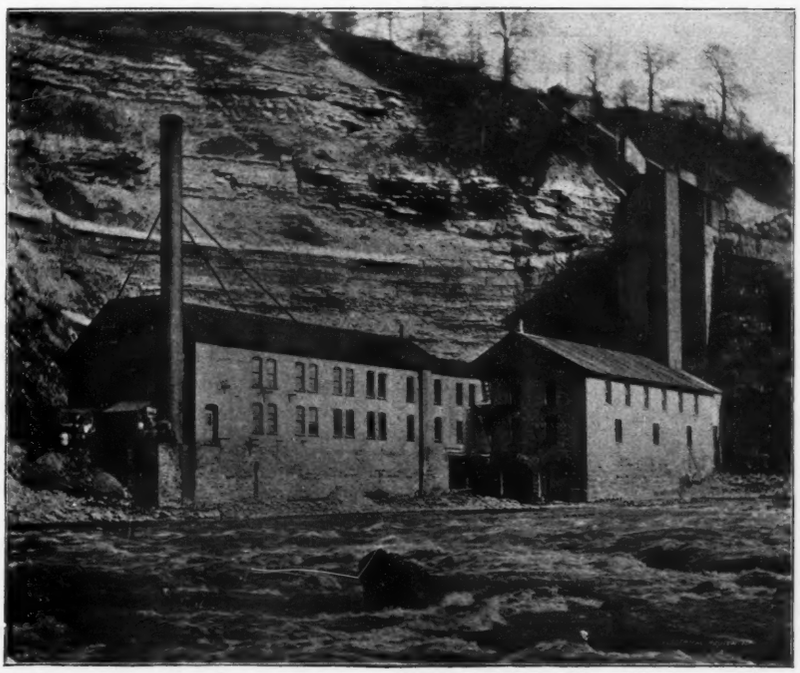


FIG. 2.—THE LOWER FALLS STATION OF THE ROCHESTER, N. Y., GAS AND ELECTRIC COMPANY.

The original first mortgage bond issue of $1,250,000, made by the old Detroit City Railway Company, and inherited by the Citizens' Street Railway Company, are to be extended. They fell due January 1, 1900. An extension of five years, it is said, is to be granted. The bulk of the whole issue is held by Detroit business men.

The Rochester Gas and Electric Company.

The Rochester Gas and Electric Company, of Rochester, N. Y., is known among central station men as a typical central station company, operating by both water and steam power. This company is a consolidation of the Rochester Gas Company, the Citizens' Gas Company, the Edison Electric Light Company, the Rochester Electric Light Company and the Brush Electric Light Company. It has in service 3,949 arc lights, 5,900 16-candle-power incandescent lights, and serves current to 2,800 horse-power of stationary electric motors.

The different stations of the company comprise 10,000 horse-power in turbines and 6,000 horse-power in steam engines. The company's subways in the city of Rochester are laid in twelve miles of streets and contain 106 miles of duct and 455 manholes. The subways are built of vitrified tile pipe and the ducts are three inches in diameter. Besides the subway system, the company has about 1½ miles of Edison three-wire mains and some 500 miles of overhead wires.

FIG. 3.—STREET ARC LAMPS IN ROCHESTER, N. Y.

The illustrations on this page, which are made from photographs taken by Mr. A. D. Rees, the night dynamo foreman of the company, show in Fig. 1 a sectional view of part of the Rochester Gas and Electric Company's subway system; in Fig. 2 the company's station at Lower Falls, and in Fig. 3 a street view showing a typical pair of General Electric arc lamps attached to a trolley pole for street lighting.

The officers of the Rochester Gas and Electric Company are the following: J. Lee Judson, president; W. L. Cole, secretary, and G. A. Redman, general superintendent of the electrical department.

ELECTRIC LIGHTING.

Wellington, Kas., has voted $14,000 for an electric lighting plant. A waterworks plant will also be built.

Fire destroyed the electric light plant at Oregon, Ill., recently. The plant was owned by F. G. Jones, a prominent merchant of that place, and was not insured.

A mortgage has been given by the Clinton Electric Company to the Kings County Trust Company, of Brooklyn, N. Y., for $50,000, bearing six per cent and payable December 15, 1919. The mortgage was given to secure first mortgage bonds of $1,000 each.

The stock of the Saratoga (N. Y.) Gas, Electric Light and Power Company has been transferred to the Hudson River Water Power Company. Rumors of this contemplated change have been rife for some time, but not until last week was the transaction consummated.

After overcoming difficulties which at one time seemed well-nigh insurmountable, the hopes of the promoters of the scheme to bring electrical energy from the Big Hole River to Butte, Mont., have been realized. Butte was lighted recently by power furnished by the plant of the Montana Power Transmission Company on the Big Hole River, three miles above Divide.

The sale of the Glasgow, Ky., Electric Light plant has been set aside by Circuit Judge Jones. The plant was sold several months ago under a judgment of court and was bought by Mr. E. A. Tuttle, of Providence, R. I. The sale was not confirmed because of the inadequacy of the price paid and insufficient advertising of its sale.

The business men of the West Side of Cleveland, Ohio, intend to revive the cooperative electric lighting scheme they originated some time ago, and it is likely they will request a franchise from the City Council for the right to string wires. Two hundred business men are interested in the scheme. They do not plan to make money, it is said, but to produce a cheaper and better light for their stores and residences.

The work on the construction of the new transmission line between the power house of the Hudson River Transmission Company, at Mechanicville, N. Y., and Troy and neighboring cities is progressing rapidly. The poles are all in position, with the exception of about 25, which are to be of extra length, and have not as yet arrived. The stringing of the wire has been completed from the power house to Waterford. The work of installing the electrical machinery at the receiving station in Watervliet is still going on, and it is thought that the power will be transmitted over the line about January 1, 1900.

City Electrician Ellicott, of Chicago, has taken the first steps in the plan to substitute electricity for gas throughout the city. Upon January 1 he turned out a large number of gas lamps, and with the money saved will put in as many electric lights as possible, at the end of three months. Next year electricity, it is expected, will replace at least 9,000 gas and

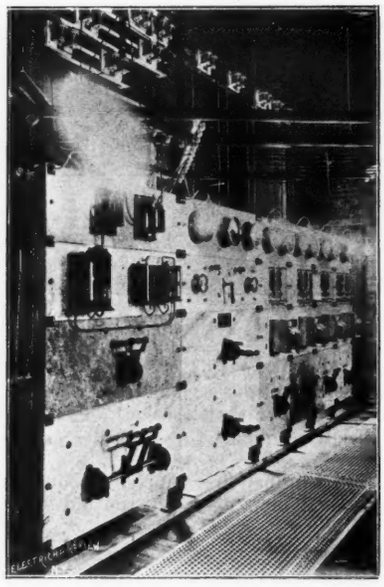


FIG. 1. THE ALBION POWER TRANSMISSION PLANT—THE SWITCHBOARD.

gasoline lamps. It costs but $55 a year to maintain an electric light, against $100 for a gas lamp.

The electric light plant of York, Neb., is now under process of extensive remodeling. New and improved machinery will replace the old and will be likewise increased in capacity. More lights are to be erected and used over the city, and to meet this increased demand new dynamos with 220 voltage, capable of sustaining 2,000 incandescent lights, will be required. A new 125-horse-power Corliss engine and equivalent boiler capacity will also be among the improvements, and for all this additional equipment a new wing to the old building, 24 by 40 feet, is now being erected.

A successful experiment with the electric plant and lights was made at Coteau du Lac, Quebec, recently on the Soulanges Canal. The machinery was set at work and the lights were started. The result was most satisfactory to the chief engineer, Mr. Thomas Munro, and others concerned, who were present. The line, which is to be used exclusively for the Soulanges Canal, will furnish light and power to open bridges and lock gates. There will also be a telephone line connecting all the locks, bridges and offices. The wires will all be on the same line of poles, which are of British Columbia's best cedar, octagonal cut, painted white. The lamps are enclosed alternating arc lights that will give light for over 100 hours without changing carbons. This work is being done by the General Electric Company, under the supervision of Mr. F. Hoffmeister, who expects to have the work finished for the opening of navigation next Spring.

A million-dollar mortgage, given by the Utica (N. Y.) Electric Light and Power Company to the Trust Company of America, was filed recently. After the consolidation of the Utica Electric Light Company, the Utica Electrical Manufacturing and Supply Company and the Trenton Falls Electric Light and Power Company into the Utica Electric Light and Power Company, it was decided to issue first mortgage five per cent sinking fund 50-year gold bonds of $1,000 each, payable January 1, 1950. Only $800,000 of the bonds have been issued. The mortgage required a $500 internal revenue stamp. It was signed by William E. Lewis, president, and Herman M. Scheuch, secretary of the Utica Electric Light and Power Company.

San Francisco has another electric light and power company. The new corporation was organized with a capital of $1,000,000. Its promoter is Prince André Poinatowski. Associated with him are William H. Crocker, William Angus, Charles E. Green and W. F. Pierce. According to the articles of incorporation $900 has already been subscribed by the promoters. The new corporation, which is known as the San Francisco Electric Light and Power Company, will probably make immediate arrangements to distribute electricity throughout the city. Underground wires will be used, and an effort will be made to transmit light and power to the residence as well as to the business districts. The current to be used in the new system will be brought from the famous plant at Blue Lakes. Power from that system is now being furnished Stockton and other towns in that vicinity. Wires are being erected south and westward to Oakland and Alameda. It is expected that the extension, which will communicate the current to this city, will be laid under the waters of the bay. A branch line will probably be used to connect San José and other cities in the Santa Clara valley with the general system.

THE ALBION, NEW YORK, POWER TRANSMISSION PLANT.

A SMALL TYPICAL POWER TRANSMISSION AND DISTRIBUTION INSTALLATION.

The Albion Power Company has perfected its transmission plant and is now furnishing a supply of current for light and power purposes in Albion, Orleans County, New York. Its generating station is located at Waterport, and the current is transmitted a distance of 6½ miles to Albion, the transmission line being erected along the highway. At Waterport the company has secured land and water rights along the Oak Orchard Creek, at a point where the banks of the stream are quite high. Between these banks the company has built a dam 12 feet high, having a weir 200 feet long and an earth embankment 100 feet long. All of the dam that is above the water is of earth and stone. This dam has the effect of setting the water back for a long distance, forming quite a reservoir, but the company controls all the land likely to be flooded by the reservoir. In this manner sufficient water is obtained to develop 400 horse power under a head of 18 feet.

FIG. 2.—THE ALBION POWER TRANSMISSION PLANT—THE DAM.

The power station has been built behind the earth embankment, the ends of which are protected by masonry piers. The flume sets into the embankment and is of unusual construction, inasmuch as it has a steel frame, the spaces being filled in with concrete. In this construction, the steel frame is designed to hold all the pressure, while the concrete makes it tight in all parts. Extending from the power house there is a tail race 1,000 feet long, which returns the water to Oak Orchard Creek. Two McCormack wheels, made by J. & W. Jolly, of Holyoke, Mass., have been installed, one having 250 - horse - power capacity, the other 175 - horse - power capacity. Both of these wheels are set in the open flume on a horizontal shaft, the discharge being through a quarter-turn and draft tube outside the flume. The larger of the wheels is connected to a 150-kilowatt generator designed to be operated at 600 revolutions per minute, and wound for a maximum electro-motive force of 6,600 volts at full-load current, the current being generated at 7,200 alternations. The smaller wheel is connected to a 100-kilowatt generator having the same general features, but which is operated at 900 revolutions per minute. These generators were made by the Stanley Electric Manufacturing Company, of Pittsfield, Mass. They are of the three-phase, alternating-current, inductor type, and are designed to operate in multiple.

In addition to these machines the station is equipped with two 6-kilowatt multipolar exciters, one of which is seen in the illustration, each exciter being capable of exciting the fields of the two generators operating on a non-inductive load. They are arranged for belt-driving from the shaft to the generator. The generators feed direct to the transmission line without the use of transformers. The Waterport station has a switchboard of blue marble.

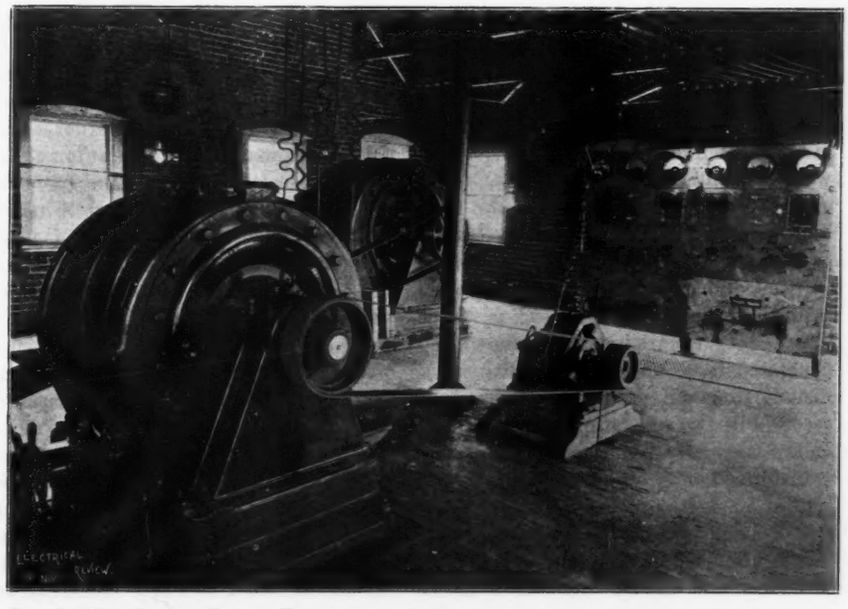


FIG. 3.—THE ALBION POWER TRANSMISSION PLANT VIEW IN STATION, SHOWING EXCITERS.

The transmission between Waterport and Albion is three-phase. The poles are 30 feet high and set 100 feet apart. The cable used is aluminum, and is made of seven pure aluminum wires. This was manufactured by the Pittsburgh Reduction Company. Locke insulators are used. They are of the triple petticoated glass variety on porcelain base pins.

When it started in business the Albion Power Company purchased the Albion station of the electric light company, and this is used as the substation. In this station three stationary transformers of Stanley type, having a total capacity of 200 kilowatts, have been installed. They are self-ventilating, for service without oil, and are designed for continuous full-load operation. They reduce the current from 6,000 volts, three-phase, to 1,100 volts, three-phase. A 75-horse-power inductor dynamo, to operate on 1,100 volts, three-phase, and for service as a synchronous motor in the operation of an 80-light direct-current Brush arc machine, has been placed in the substation. Also a one-kilowatt exciter to excite the fields of the motor and one 5-horse-power, three-phase induction motor have been installed. The substation is equipped with a steam relay up to the station's capacity.

In Albion three districts have been laid out, and in each district there have been installed three 300 - light transformers, connected in multiple and stepping down to 110 volts. One leg of the three-phase line is connected to each district. In addition to this service a three-phase line runs about the village outskirts. The plant is most successful. The Niagara Electric Company, of Niagara Falls, had the contract for the work. Hon. Frank A. Dudley, of Niagara Falls, is president of the Albion Power Company, and Wallace C. Johnson, of the same city, is chief engineer and manager. The men interested are understood to have similar projects in view.

FOREIGN ELECTRICAL PROGRESS IN 1899.

The Continent of Europe.

In general the year 1899 was one of considerable progress and activity in all of the manufacturing countries of the Continent. The labor disturbances and other adverse conditions which have obtained in England have not affected to any degree the work of manufacturing establishments in France, Germany, Switzerland and Italy, and these have enjoyed a great degree of prosperity and turned out an enormous total of output during the year.

FRANCE.

Of course, the topic of first importance in France is the coming exposition, and work upon all branches of it is being pushed with almost feverish activity to allow the completion of the buildings in time for the opening in May. For this exposition, or rather inspired by it, two engineering works of the highest importance have been begun in Paris. One is the construction of the underground extension and terminus of the Orléans Railway, from the Place Valhubert to the Quai d'Orsay, on the banks of the Seine, opposite the location of the exposition buildings. This extension consists of a double-track tunnel about two miles long, constructed partly below the level of high-water in the Seine and running along under the quais or landing docks on the left bank of the Seine. It is needless to say that innumerable difficulties in the way of bridge abutments, sewer openings, etc., were encountered, and the work of the civil engineers in charge must be most highly commended. At the new station on the Quai d'Orsay the most elaborate shifting and shunting devices have been installed. The whole railroad is to be operated by electricity, the current being generated in a station about five miles distant from any part of the line. It is received in two substations, one at either end of the underground section, and there transformed and converted to direct current at 500 volts for the operation of electric locomotives in the tunnel. At the same substations part of the current is also to drive electric lighting dynamos through the agency of synchronous motors for the illumination of the tunnel and stations. It is expected that this railway will handle a very large portion of the suburban traffic to and from the exposition, and arrangements have been made to run trains at headways as short as one minute, to accommodate the great crowds that are expected.

The other important work is the construction of an underground, electrically-operated railway directly across Paris. Almost superhuman exertions are being made to finish this in time for the exposition, and it is thought that, unless some unforeseen accident takes place, some sections of it, at least, will be in operation by that time. In construction it will not differ greatly from the upper level underground railways in London, but it will be adequate for the transportation of a large number of passengers and will afford Paris a transportation system infinitely in advance of anything that it now possesses.

Next to these large works of engineering, certainly the most prominent development of electrical application this year has been the extension of electric automobile manufacture and use. Large charging stations have been built for the public cab service in Paris, and many establishments for the construction of the vehicles have been started. It is noticeable that the French accumulator still holds its own as the best for automobile use, though it is beginning to be noticed that a large percentage of the manufacture itself is going to Belgium. This is probably on account of labor and political considerations.

The Automobile Club de France, by its intelligent and active labors, and especially by the annual expositions it holds, has contributed more than any other single agency to the advance of automobilism in its country. This institution, while formed originally to promote automobilism and the social feature of the sport, has exercised a very great and beneficial influence upon the industry of manufacturing automobiles and all their accessories, including, of course, storage batteries.

In electric lighting there has been no notable development in France, except the construction of a great central station by the Compressed Air Company. This is not different from other large central stations for the generation of direct current, but it employs a system of five-wire distribution and several accumulator substations which form a unique whole. The feeder cables are of a type similar to submarine cables and are laid in sand in ditches, cut in the soil, without other protection.

In Savoy there has been considerable development of water-power for use in electrolytic works. These are of the usual type, the heads of water being ordinarily of great height and some type of impulse turbine being employed with them. The manufactures are the usual chemical products—aluminum, soda, bleaching powder and the like. This part of France, being intersected with numerous mountain streams fed from the snow of the nearby Swiss mountains, seems to be destined in future to be the scene of large and important industrial applications of electric power.

GERMANY.

In Germany the direction of electrical advance has been noticeably different from that in France. There have been no very notable engineering works executed or begun, but there has been, perhaps, more invention than in any other country and some very interesting results have been obtained, which may in future prove of considerable value. Perhaps the first in interest among these is Dr. Nernst's electric lamp. This, as is already well known, consists of a little rod of some highly refractory electrolyte, such as oxide of magnesium. At ordinary temperatures this is a high insulator, and when the little rod is connected to a source of alternating current none will pass through it. When it is warmed, however, it begins to conduct, and soon attains an enormous temperature, emitting a brilliant and pleasing light. It is claimed that this light is remarkably efficient in output of candle-power per unit of current absorbed; but many practical difficulties still stand in the way of its successful utilization. Among these the most important is the necessity for warming the rod before it will light, thus requiring matches or some other source of flame to be used in lighting the lamps. A controversy has arisen, also, as to whether the lamp was not invented and described by Jablochkoff.

In telegraphy successful experiments have been conducted between Berlin and Budapesth by Herren Pollak and Virág. The instruments employed by them are of the type using a punched paper tape, running under contacts, at the sending end and a highly sensitive d'Arsonval galvanometer at the receiving end. This carries a mirror and the deflections of the spot of light thrown by it are registered photographically upon a sheet of sensitized paper. It is claimed that speeds as high as 150,000 words per minute have been attained with this apparatus over long ordinary land lines.

In Hanover the composite electric tramway system has been giving great satisfaction. In that city the authorities forbade the use of the overhead trolley in the central parts, though allowing it in the suburbs. Consequently, cars were equipped with storage batteries, which were charged from the trolley current

itself while they were running in the outlying districts and which served to propel them through the thickly built portions of the city. The batteries, working always near their maximum charge capacity, seem to suffer little deterioration and to have given great satisfaction.

All over the German Empire there has been a marked and noticeable extension of electric railways. Some of these lines have been very admirably constructed, such as, notably, that between Elberfeld and Barmen.

During the Summer an automobile exposition was held in Berlin, and no little interest was manifested in electromobiles. While these vehicles are sufficiently numerous upon the streets of the larger German cities, they are not as yet manufactured in any large number in the empire. It appears to be a tendency of German engineers to work rather upon the heavier types for handling goods, omnibuses and the like, than upon lighter pleasure vehicles.

Germany is the home of electro-chemistry. Already vast works for the manufacture of the usual chemical products of electrolysis are in operation, and a great number of manufactories on a smaller scale are using electric current in the production of the rarer chemicals, drugs and dye stuffs. Electrolytic methods are in use now for the making of aniline colors, photographic and medicinal chemicals, such as quinine, as well as the gross bleaching powders, sodas, etc.

ITALY.

Somebody has said that Italy is the land of white coal. On the summits of the Alps, in the northern part, and the Appennines, along the backbone of the Peninsula, are great fields of snow which are the source of innumerable waterfalls and torrential streams. This natural supply of power has been very indifferently utilized, although every ton of coal burned in Italy is imported, none being found in that country. During the past year there has been an enormous awakening of interest in the utilization of these powers, and the establishment of manufacturing industries in Italy based upon them. Naturally the use of electrical transmission has grown with the increased use of water-power, and some very fine stations have been established. Among these is the superb installation at Paderno d'Adda, from which power is transmitted for the lighting of the city of Milan, a distance of 22 miles.

The year's feature in Italy has been the electrical exposition and congress of electricians at Como in honor of the centenary of the invention of the battery by Alessandro Volta. Unfortunately, this occasion was seriously marred by a destructive fire in the exposition building which consumed, among other things, several of the relics of Volta.

OTHER COUNTRIES.

Outside of the larger states referred to above, perhaps the most interesting developments have been in Switzerland. This little country is already noted for the magnificent electrical manufacturing establishments it contains and for the noteworthy works of engineering through which its great water-powers are utilized. The work on the tunnel railroad to the summit of the Jungfrau has progressed sufficiently to permit the opening of the lower section. This is one of the very few railways in the world operated directly by polyphase current, the track and two trolley wires being used for conducting three-phase currents to the car motors.

The Scandinavian countries still maintain their curious superiority in the number of telephones used per unit of population. Stockholm is said to have more telephones for its population than any other city in the world, and its exchange and lines are very substantially and admirably constructed.

Russia still continues to be a country in which there is practically no manufacture of electrical apparatus,and no great market for supplies.

In Spain the only work of importance during the year has been the extension of electric lighting in Granada, and the use of electric cranes on the docks at Barcelona.

Great Britain.

The year in Great Britain was marked by no revolutionary advance in any direction of electrical activity. Indeed, it was one of the quietest, so to speak, that has passed since the electric arts have taken their place as important factors in industry. Perhaps it is fair to say that the most prominent feature of the year's work has been competition from your side of the water. It is hardly necessary here to go into the details of the success which has marked the efforts of American engineering and manufacturing firms to place their goods in British markets and in competition with British makers. You will doubtless recall at once the prominent examples—Glasgow and the Central London Underground Railway—that raised so great a volume of comment, and even of protest, in this country. Both these installations are practically American throughout; indeed, the only features of the latter that are of British workmanship are the bricks which line the tunnels and the crossties under the tram rails in them.

It is perhaps better worth while to attempt an explanation of the causes that have led to successful competition on the part of your engineers than to enter into any description of the plants which they have installed or contracted for. Probably first among these causes may be placed the great engineering strike of last year. In this country trades unionism has grown to such a point that the union has virtually dictated to the employer his business policy. Among the most oppressive features of this dictation has been the ruling of the union leaders that each man shall operate only one machine tool. This one-man one-machine edict (which was like a law of the Medes and Persians) naturally cut down output and vastly limited the productive capacity of the plant and investment. When the employers, suffering already to some degree from competition, disagreed on vital points with the laborers, the result was a widespread strike which totally crippled and almost paralyzed the productive industries of Great Britain. This came at a time when shops were filled with orders and when much depended upon haste in production and swiftness in delivery. The consequences were, first, that the users of manufactured products naturally sought them in the most available market; and, second, that American and German goods which came in to supply this demand, having proved their excellence, retained to a large degree their hold upon popular confidence and established in this way an import trade in these articles from your side of the water and across the North Sea.

As you doubtless know the municipal authorities in all sections of this country move very slowly in the consideration of matters of public importance. It is, perhaps, for this reason that there has been so slow an upbuilding of the electric tramway industry over here; but, nevertheless, these roads are increasing in number, many of them growing in length, and many of the objectionable and often ridiculous restrictions which hampered their progress have been removed as a clearer understanding of the true nature of their operation has become widespread.

In electric lighting the principal advance has been in the direction of increased voltage on direct-current supply mains. All over the Kingdom installations operating at 110 volts have changed over to 220, and the three-wire 220–440-volt system is now established her, despitee some difficulties which it encountered in its youth from boards of trade and other municipal institutions. Rectifier arc lighting has also been introduced from a number of the larger stations, the fine station of the Hammersmith vestry in London being a conspicuous example of the successful use of this variety of current in illumination.

It is gratifying to notice that electrolytic plants are being constructed in great numbers, especially in the mountainous districts of Scotland, where abundant water powers can be had and where many thousands of horse-power are running to waste. The aluminum plant at Foyers, Scotland, has been now in successful operation for some time and is producing a large output. In these districts, also, there have been erected numerous establishments for the manufacture of bleaching powder, soda, chlorate of potash, etc., by electrolytic processes, and the importation of these articles into the British Isles have been noticeably lessened by the supply already produced by the new establishments. There is no doubt that this branch of industry is destined to become an important one in Great Britain, and although it is already of a somewhat sturdy growth, it is doubtless still in its infancy (as people are so fond of saying that everything electrical is).

One of the most spectacular, if not the most important, advances that has been made in this country during the year has been that of the art of wireless telegraphy. Great success has attended the labors of Mr. Marconi and his associates in their efforts to perfect the system of signaling which bears his name, and to adapt it for commercial and military uses. The striking demonstrations between the South Foreland lighthouse, the Goodwin Sands lightship and Boulogne, in France, were followed by the highly successful demonstration on ships of the channel squadron cruising off the southwest coast, when communication was established and signaling carried on between vessels over 90 miles apart. So great was the success of this demonstration that the Admiralty has decided to equip a large number of vessels with the apparatus, and it is thought that it will be possible by its aid greatly to facilitate the work of scouting and cruising ships and those engaged in blockading and coast defense. So far the most strenuous effort to make the wireless telegraphy apparatus non-interfering and to direct the signals have met with no success.

The subject most prominent before us here at this moment, is naturally the war. It has been a subject of adverse and even bitter comment that the war office did not provide the various expeditionary forces in South Africa with wireless telegraphy apparatus. A belated shipment of these has been made, but if General White had been provided with them much suspense and anxiety over the condition of affairs at Ladysmith would have been avoided, and, doubtless, important military information could have been conveyed. No words of praise are too great, however, for the work of the military telegraph corps in the difficult region of South Africa. A curious illustration of the availability of electric searchlights in war has been shown by the advance for the relief of Kimberley. The forces on the Modder River, about twenty miles away from that town, communicated and are still communicating with its garrison by means of searchlight flash signals thrown on the clouds at night. It is said that the Boers were even more afraid of these signals than of the more offensive arms carried by the British Army.

To sum it all up, the year has been one of great activity in all directions, but has also been marked by the initiation of a competitive condition which it is not yet possible for British manufacturers to view with entire satisfaction. At the same time, the edge of the discontent has been more or less blunted by the growing feeling of fraternity which has made the talk of an Anglo-American alliance possible.

H.

London, December 23, 1899.

LONDON NOTES.

[*From our special correspondent.*]

Perhaps the incident of the week, from our point of view, has been the spirited attack made by Sir Edward Sassoon upon the rates charged by the cable companies; which he justly described as "one of the most gigantic impositions to which any civilized community had as yet to submit." When you consider that it costs 4s. to send a word to India, 5s. to Shanghai, and 7s. 1d. to Lagos, remembering that with China and India our business dealings are exceedingly large, while with Lagos they are rapidly developing, you can realize something of the drag which these rates are upon our commerce. In the meanwhile, a wire to Vancouver's Island, which is 800 miles more distant than Lagos, costs 1s. 6d. a word only, and there are plenty more anomalies of the same kind which might be quoted. Thus you may send a message to Alexandria for 1s. 7d. a word, but to Accra, which is the same distance from this country, you are charged at the rate of 6s. 3d. It is the old story of monopolies and rings and, let the old Adam in our business men rebel as it will, it is difficult to see how, considering the vested interests and the position and influence of the persons involved, these scandals are to be remedied. However, the present time affords something of an opportunity, in that the public, eager for news of the war in South Africa, have now been several times exasperated by the failures of the cables upon which they have to rely. If this feeling could be skillfully worked up, some thingmight be done.

While on the subject of cable arrangements, it is worth while noting that an enterprising daily paper has succeeded in proving that the officials of a well-known news agency in Cape Town were in Boer pay. The assertion was made and allowed to pass uncontradicted; other journals began to ask why the agency in question did not prosecute for libel. The agency, however, took the wiser course; they looked into the matter, and dismissed the principal officials, admitting thereby the truth of the charge. Hints have been dropped that other telegraphic news agencies are not beyond reproach in this particular, and I should not be surprised if further revelations were made.

I think that I warned you against placing implicit confidence in the story that the arrangements for installing electric traction upon the London underground railway systems were nearly completed. It is now admitted that they are nothing of the kind. As I personally am convinced that the so-called experiments are only an ingenious device for throwing dust in the eyes of the public and staving off the evil day when electricity will have to be brought in, I am not at all surprised at the disclaimer. The very smart financier who controls the destinies of these railways is not in the least likely to incur the expenditure necessary to make this change, until he is absolutely obliged.

The indirect effects of the war are a little astonishing at times, and not invariably convincing. Some of the electric lighting companies being put on their defense during the past week for allowing black smoke to be emitted from their chimneys, have pleaded that the government has absorbed all the available supplies of Welsh coal, and that they are obliged to put up with coal of inferior quality in consequence. Of course, this is not a sufficient answer, seeing that skillful stoking plays a very important part in the matter, but the plea is, in part at least, true, and so far illustrates what I said.

London, December 15, 1899.

Chicago Electrical Association.

The next meeting of this association will be held in Room 1741, Monadnock building, Chicago, on Friday evening, January 19. Mr. Bion J. Arnold will read a paper on "The Arnold System of Power Station Construction."

Electrocution in Massachusetts.

Edward Snow was found guilty of murder on January 1, at Barnstable, Mass., and sentenced to be executed by electricity. This will be the first electrocution in the state.

A Typical Converter, Motor-Generator and Storage Battery Substation Plant.

Some of the substation work in the application of Niagara power to electric lighting and railway work is exceedingly interesting. The view presented herewith embraces the switchboard and charging sets of the Edison system used in the downtown district of the Buffalo General Electric Company. The machinery consists of two 100-kilowatt rotary converters of 25 cycles at 750 revolutions per minute, one motor-generator set consisting of one 425-kilowatt synchronous motor with revolving field, the stationary primary taking current at 352 volts, direct-connected on each side to a 200-kilowatt direct-current generator.

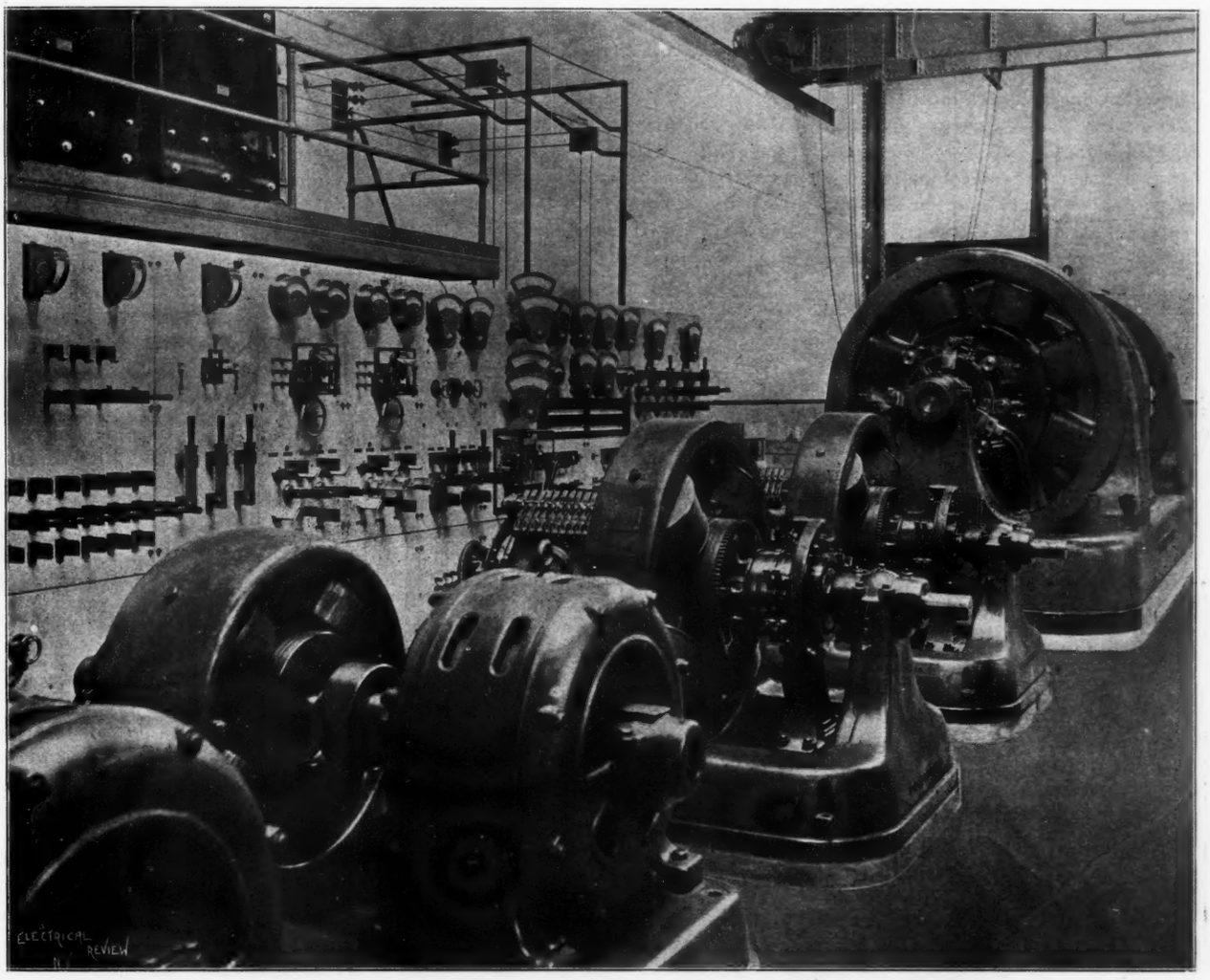
The starting of the motor-generator set is done from the direct-current side, thereby bringing the motor into synchronism in the simplest manner possible. The voltage of the direct-current generators has a range of 120 to 190, the two generators being connected in series, and the neutral wire of the three-wire system connected between the two generators.

In the foreground of the view is shown a small direct-connected set. This consists of an induction motor, operating at 352 volts, and a four-pole direct-current generator furnishing direct current for exciting the fields of the synchronous motors. Next in order in the picture are two 100-kilowatt rotaries followed by the charging set, which latter was in operation at the time the picture was taken.

The switchboard is shown entire. Beginning at the left the first panel shows two ammeters of the edgewise pattern and a three-pole quick-break switch for controlling the primaries of the transformers used in connection with the rotaries. The next row of six single-pole double-throw switches have their centres connected to the collector rings of the rotaries, the bottom contacts being connected to the reactance coils used in starting. After the rotaries have attained the speed of synchronism the single-pole switches are thrown up, thereby cutting out the reactance coils.

The second panel of this board contains an ammeter, field switch, synchronizing switches and three single-pole, single-throw main switches, all of which pertain to the operation of the synchronous motor of the motor-generator set.

The third and fourth panels control the direct-current sides of the rotary converters. On each panel are mounted one voltmeter and ammeter, double-throw, double-pole field switch, wattmeter, field rheostat and two five-point switches. The centre of the five-point switches is connected to the brushes of the rotary, while the contacts lead to the positive main, positive auxiliary, neutral, negative main and negative auxiliary, thereby affording a ready means of checking any unbalancing. The fifth panel controls the two direct-current generators of the motor-generating set. The sixth panel is the load panel for the system. The seventh panel controls the end-cell switches, and the last is a feeder panel.



VIEW IN THE DOWNTOWN SUBSTATION OF THE BUFFALO GENERAL ELECTRIC COMPANY, BUFFALO, N. Y.

All of the machinery was made by the General Electric Company, and the storage battery, not shown in the cut, was manufactured and installed by the Electric Storage Battery Company.

The Buffalo General Electric Company has one of the most modern and complete plants in existence, for which much credit is due to its general manager, Mr. Charles R. Huntley, a former president of the National Electric Light Association.

EXPORT NOTES.

Steel and iron rails are wanted in Australia, according to Consul Goding, who writes from Newcastle, N. S. W., saying: "There is a great scarcity of steel and iron rails in this colony. Should our manufacturers look into the matter at once I believe they could secure a large order—perhaps £200,000 worth. The colonial authorities are very anxious to obtain rails, and, I am led to think, may consider favorably orders from the United States."

The East Chinese Railway authorities of St. Petersburg, Russia, have just placed an order with Ganz & Company, of Budapest, for the establishment and equipment of a large central power station at Port Arthur, to supply the electrical energy for the lighting of the port and for the operation of the dock cranes, etc. The Austrian Schuckert Company, of Vienna, has secured a contract for the establishment of a large electric lighting and power transmission plant at the new colliery at Duby, for the Bustehrad Railway Company. Considerable material and machinery will be required for both undertakings, for which American manufacturers might advantageously compete.

A recent mail from Havana brought inquiries to a New York firm for two small electric light plants which are needed in sugar plantations. In such a hurry are the purchasers of these plants for the equipment that prices had to be cabled at once, giving full particulars. The demand for railroad supplies from Cuba was never as active at this season of the year before. Within a few days $11,000 worth of car material has been sent to Havana, and also $8,000 worth of rails. The ability of merchants to secure manufactured iron goods, such as pipe, sheets, etc., has also been the means of several good-sized contracts having been placed of late. There is every indication that trade with Cuba will increase shortly after the new year.

The Italian Government, through its State Railway Department, is at present trying to place with car manufacturers in this country orders for 200 passenger cars and some 1,000 freight cars. This, it is stated, will mean an expenditure exceeding $2,000,000. The cars are needed to replenish the rolling stock of the Genoa, Rome, Naples and Brindisi lines. Two new railroad lines are to be built in Italy early next year, and the government has accorded a credit of $8,685,000. For the undertakings 111 locomotives are required, 458 passenger cars, 56 baggage cars, 3,050 freight cars and four automobiles. Half of this equipment must be furnished by home manufacturers, but the other half may be awarded to foreign competitors. This will give an idea of activity of railroad construction in Italy.

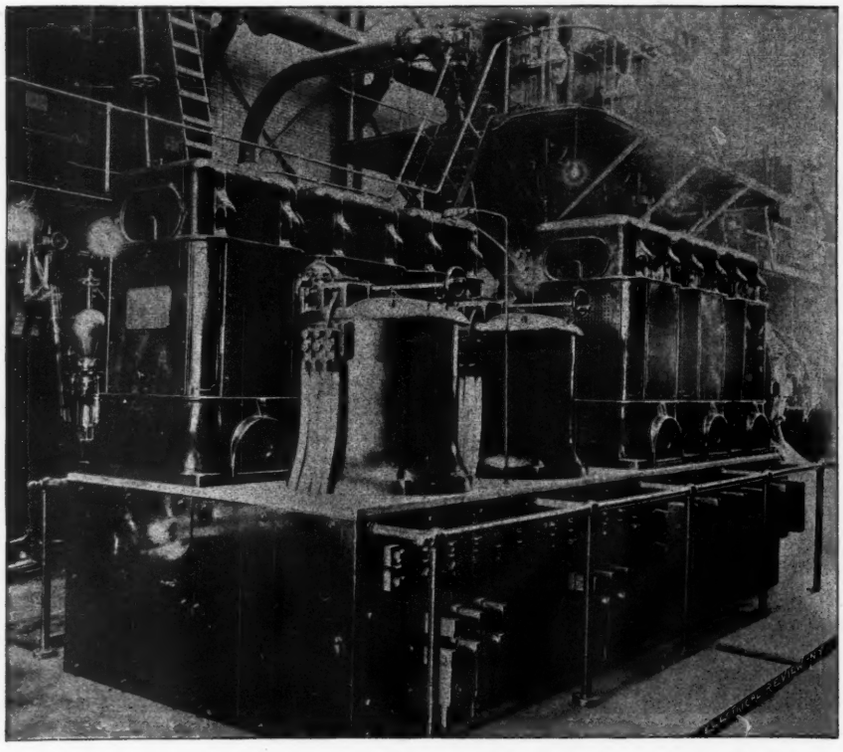


FIG. 2.—GROUP OF STATIONARY TRANSFORMERS IN THE CHICAGO EDISON COMPANY'S STATION.

Electrical Machinery in the Harrison Street Station of the Chicago Edison Company.

The machinery illustrated herewith is part of that installed in the Harrison street station of the Chicago Edison Company. Fig. 1 represents the double-current generators. These machines are closely analogous to rotary converters in construction, and supply current simultaneously to the busbars of the low-tension direct-current distribution system, and three-phase current at 25 cycles per second to a group of stationary transformers for stepping-up to a high voltage for transmission. Each of the machines is of 200 kilowatts capacity, and runs at 150 revolutions per minute. As will be seen, they are direct-coupled in pairs to vertical compound engines of 600 horse-power. A feature of their construction is that the three collector rings for taking off the alternating current are located in a recessed portion of the direct-current commutator. This construction is well shown in the right-hand machine at the centre of the illustration.

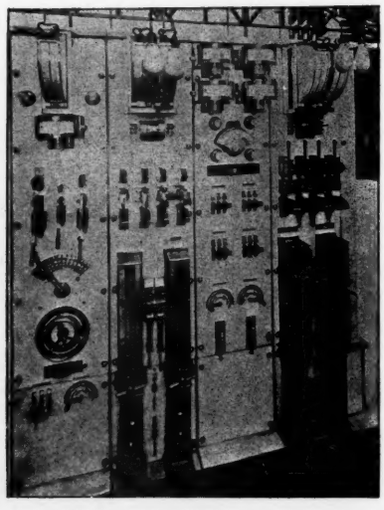


FIG. 3.—CHICAGO EDISON STATION—SWITCHBOARD PANELS.

Fig. 2 shows a group of stationary transformers with their regulators These induction regulators first receive the current from the alternating side of the generators and pass it through switches to fuse-blocks and the stationary transformers. The potential of this primary supply is about 80 volts, corresponding to the direct-current 115 volts supplied by the commutated side of the machines. The stationary transformers of which the illustration well shows a bank of six, raise the potential to 4,500 volts, at which pressure it is fed to the transmission lines. Passing from the transformers the current goes through expulsion fuse-blocks.

Fig. 3 shows the switchboard panels,

from which are controlled two sets of double-current generators and one rotary converter. The two panels controlling the direct-current sides of the generators are the first and third, counting from the right. The alternating side of both sets is controlled from the panel located between these two, or the second from the right. The rotary is controlled from the panel on the left. The main high-tension, alternating-current switches are pneumatically operated, but are controlled from the same panels. This simple and compact switchboard supplies current for a rotary converter substation and for power purposes. The generators and the rotary can be run in multiple. The remarkable feature of this installation is that, by the extreme flexibility secured in the use of double-current generators and converse rotary converters, an economical load for the engines can be secured at any time, and that in stations, such as this one, supplying both business and residence districts, where the peaks of the loads come at different times, one investment in engines and generators will serve both purposes.

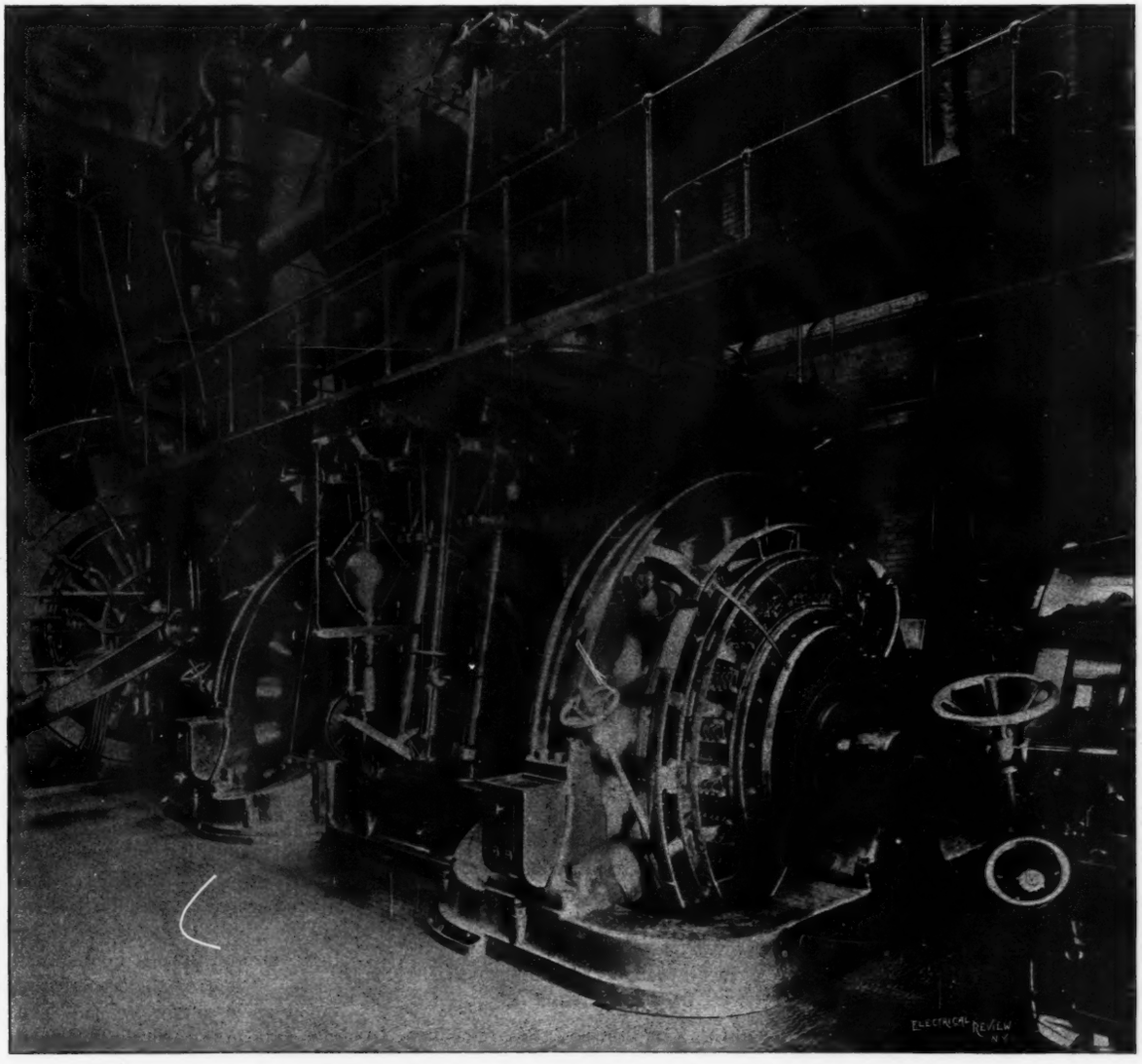


FIG. 1.—CHICAGO EDISON STATION. MAIN ENGINES AND DOUBLE-CURRENT GENERATORS.

AUTOMOBILES.

The Board of Park Commissioners, of New York city, has granted a permit to Miss Florence E. Woods to operate an automobile in Central Park. This is the first permit of the sort issued to a woman. Before receiving the permit, Miss Woods, who is about 17 years old, demonstrated her ability to operate her automobile skillfully.

St. Vincent's Hospital, New York city, will soon put in service a new electric ambulance. It was a gift from a benefactor of the hospital and cost $3,000 to build. It is similar to the ambulances already in use, but is equipped with sliding glass doors for use in stormy weather. The ambulance has a maximum speed of 10 miles an hour.

Automobiles are to replace horses in the Chicago post-office service in transferring the mail from station to station and to and from the railroad stations. Mail wagons of the latest pattern have been turned out, and recently an official test was made of the new vehicles. Postmaster-General Smith, after viewing the work of the new wagons, recommended that contracts be awarded for the service.

The Fifth Avenue Coach Company, of New York city, on January 2 made a trial trip of an electromobile stage from Eighty-eighth street and Fifth avenue to Washington square and return. The total weight of the experimental vehicle is 5,500 pounds. The maximum speed is nine miles an hour. It carries 1,500 pounds of chloride accumulators. It has seating accommodations for eight passengers on the inside and four on the top, one of whom sits beside the operator. This vehicle was not originally designed for use on the Fifth avenue line, but being the largest one that has been built, the managers of the line and of the Electric Vehicle Company, which owns the stage, decided to make the experiment which will last indefinitely.

AN IMPORTANT TELEPHONE SUIT.

FIGHT OF BELL AND INDEPENDENT INTERESTS OVER A CONGRESSIONAL ENACTMENT.

To the Editor of Electrical Review:

The telephone suit now awaiting the decision of Judge Barnard, of the Supreme Court of the District of Columbia, is of vital importance to all telephone interests in the United States. The cause is entitled James F. Manning *et al. vs.* The Chesapeake & Potomac Telephone Company. It is a test case on the result of which the suits of about one hundred other subscribers of the company depend. These subscribers have been granted injunctions restraining the company from removing the instruments from their premises for non-payment of the rentals at the rates established by the company.

On June 30, 1898, Congress passed an act which provided that from and after the passage of this act it shall be unlawful for any person, or any telephone company doing business in the District of Columbia, to charge or receive more than $50 per annum for the use of a telephone on a separate wire; $40 for each telephone, there being not more than two on a wire; $30 for each telephone, there being not more than three on a wire, and $25 for each telephone, there being four or more on the same wire.

The company refused to obey this law, ordered out the instruments of those subscribers who declined to pay the old rates, and the pending suit resulted. It has been in progress for more than a year. Judge Barnard recently spent two weeks listening to the reading of the testimony and one week hearing the arguments of counsel and his decision is looked for early in January. The case has been prosecuted with great vigor and determination and testimony has been taken in all the principal places where opposition exchanges have been started. The Chesapeake & Potomac Company has presented many facts and statements showing what has been the actual cost of operating exchanges; the opposition has brought out a great mass of testimony showing the telephone business from their standpoint. The company contends that the statute fixing the fifty dollar rate is unconstitutional, because at that rate no return or reward on the capital invested can be earned and that its enforcement would practically destroy its business. The opposition bases its main argument on the long since exploded notion that an increase in the number of subscribers in a telephone exchange decreases the cost per subscriber, and that the rate should be lower in the large city exchanges, with many subscribers, than in the small country exchanges, with few subscribers.

In 1881 a considerable number of the subscribers of the Washington exchange combined to force the company to furnish the service at $25. To satisfy them that such a reduction was impossible the company published a statement, taken from its account books, which showed that the operating expenses were:

For	523	subscribers..... $35.28
"	546	" 36.24
"	584	" 36.36
"	611	" 38 76
"	619	" 40.80
"	700	" 45.69
"	800	" 52 22
"	9 0	" 58 52
"	1,000	" 65.28

The exchange now has 2,700 subscribers, connected partly by metallic and partly by grounded circuits, ranging in length from 100 feet to six miles, and in the number of calls per subscriber from 700 to 35,000 annually, and this service the Manning lawyers declare can be done at a flat rate of $50 and leave the company a good profit.

The fight is really between the American Bell interests and the opposition companies. The interests of the Washington exchange subscribers is a comparatively unimportant matter. If the rate fixed by Congress should be finally maintained, it would be a severe blow to the Bell Company, and it would be a worse blow to the opposition companies. While the latter were simply in the speculative stage, anything that gave them notoriety could be turned to their advantage. Now that they are getting on a business basis, the success of the Manning suit would be the starting of a fire which would burn over the fields from which they expect to reap a harvest. It is in the air that they are considering the necessity of taking steps to have the congressional enactment repealed. If this is not done, the Manning case will, in all probability, be carried up to the District Court of Appeals and, finally, to the United States Supreme Court.

G. C. M.

Washington, D. C., January 2, 1900.

Public Telephones and Microbes In Paris.

Parisians are becoming nervous over the danger of contracting contagious diseases from using public telephones. A scientific commission, composed of Drs. Grancher, Roux Nocard and See, appointed to study the question, has just made a report which states that no instance of contagion due to this cause has been proved, but recommends that in the public interest the telephonic apparatus be wiped off daily with a damp cloth, dipped in a solution of water, with three per cent of phenic acid. The director of the telephone service has given instructions that these measures be taken regularly.

VIEWS, NEWS AND INTERVIEWS.

An Italian employed by the New York Telephone Company in some work in New Rochelle, was sent for some dynamite one day recently. Early the next morning the man brought it from New York on the trolley cars. He had the dynamite in a bag, which he placed on the floor of the car. A policeman seeing the man with the bag asked him what he had in it, and at the same time hit the bag with his night stick. When the Italian told the officer it was dynamite his hair nearly raised his hat from his head as he realized the narrow escape he had from being blown into eternity. The policeman took the man to the police station, and when he was arraigned in the City Court he was fined $100 for violating the ordinance against carrying dynamite through the city without a permit. The local manager of the telephone company said he would furnish the money.

Colonel Cody (Buffalo Bill) proposes to build an electric light plant for his home town of North Platte, Neb.

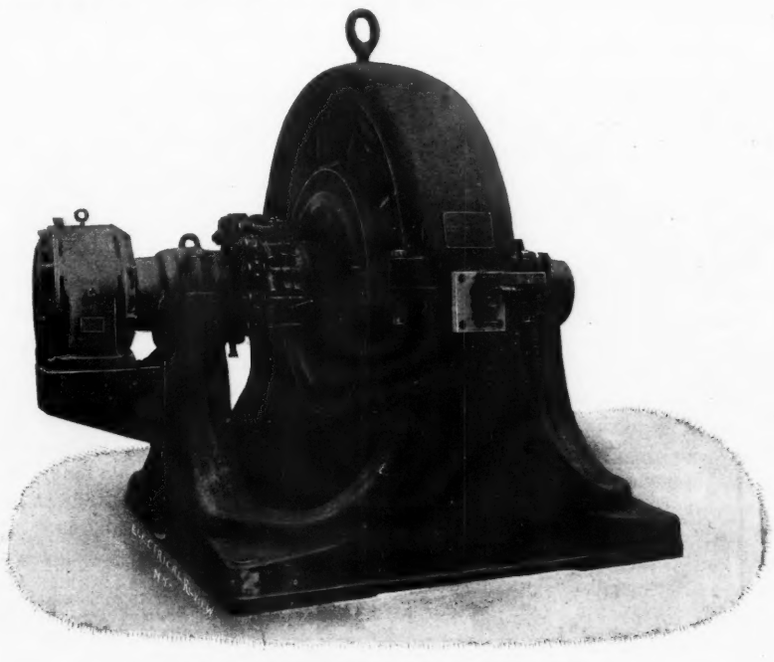
"Last evening about six o'clock, one of the employés of the Electric Power Company was in the act of turning on the street lights at the station on lower Main street," says the Grass Valley, Cal., *Union*, "when in some manner a large arc was formed and a terrific noise followed, also the basement of the building was lit up in a brilliant manner. Immediately another arc was formed on the large marble switchboard, lighting up all of lower Main street and melting two of the large switches. One of the employés happened to be in the room at the time, and, with great presence of mind, turned the switch off, but not before the marble board had been damaged and the switches melted away. A fuse burned out in one of the large transformers, causing the lights around town to go out for a minute or so. None of the employés was hurt, but it was a narrow escape. The damage is mostly to the switchboard."

The street railway in Bangkok, Siam, was built by a syndicate which secured a concession in 1887. The original road was a horse line, and was changed to an overhead trolley system in 1892. A recent consular report states that the road is crowded with passengers at all hours of the day and is paying a 12 per cent dividend on the investment. The apparatus for the road was purchased in the United States and the rails were bought in Europe. It is probable that the present line will soon be extended and that another similar road will be built.

The Largest Rotary Converter.

The rotary converter shown in the accompanying illustration is one of several built for the Third Avenue Railroad Company, New York. They are the largest ever constructed, being of 1,000-kilowatts capacity each. The Westinghouse Electric and Manufacturing Company, the builders, have recently contracted to supply several rotaries of 1,500 kilowatts for the Manhattan Elevated Railroad, New York, but these larger ones are not yet in hand.

The rotaries are to be installed at the different stations of the Third Avenue Railroad Company. They have a normal rating of 1,000 kilowatts, three-phase and 25 cycles per second; 10 poles, run at 300 revolutions per minute and deliver 550 volts on the direct-current side, the voltage on the alternating-current side being approximately 340 volts. They are of the standard Westinghouse type, having laminated poles, and are compound-wound. The external frame of the rotary is divided in a horizontal plane.



THE LARGEST ROTARY CONVERTER IN THE WORLD.

Six of the rotaries now installed in the stations of the Third Avenue Railroad are provided with an extended shaft and third bearing, and are used as double-current or double-end generators. When operating as double-end generators the machines are able to deliver their full rated load continuously on either the alternating-current or direct-current ends, or they are able to deliver any proportion of their load on the two ends continuously, provided the sum of the loads is not in excess of the normal full-load rating of the machine. The machines are designed so as to have large overload capacities, so that when operating under full load continuously the rise in temperature is necessarily low.

The frames of the double-end generators are so arranged that they can be changed to rotaries whenever desired. This can be done by cutting off the shaft and by the addition of an induction motor for starting and a bracket for supporting the starting motor. The frame is so arranged that the bracket may be readily added. The rotating part of the starting motor is pressed upon the armature shaft of the rotary.

When operating as a double-end generator the direct-current end feeds directly into the railway system, while the alternating-current end has its voltage raised by means of step-up transformers, and current is transmitted to the substations, where it operates rotaries, which in turn feed into the common railway system.

Some of the good features of these rotaries are: enormous overload capacity; good commutation from no load to 100 per cent overload, without rocking the brushes, and high efficiency. The collector is of the "open" type, affording extremely good ventilation, with a consequent low rise in the temperature. The commutator and brushes are of ample size to carry safely large overloads. The brush-holder arms and brushes are carried by a rocker, supported from the yoke of the machine in the same manner as in the Westinghouse engine-type direct-current generators.

EUROPEAN MANUFACTURERS.

BY GEORGE H. BENJAMIN.

FOR ELECTRICAL REVIEW NEW YEAR DOUBLE NUMBER.

During a recent visit to Europe and in conversation with a large number of manufacturers and users of electrical machinery, I was struck by the fact that the chief objection urged to American machinery was to its finish. A prominent manufacturer said to me: "I like to have my machinery shine, for the same reason that urged Napoleon the First, prior to one of his great battles, to order the shoes of all his soldiers polished—for the moral effect." "I find," he said, "that if a machine is well finished and has some bright parts about it, it creates a pride on the part of the man or men having it in charge, with the result that it is carefully tended and its lifetime prolonged." The practice in Europe is to carefully finish all machines. All painted metal parts are, as a rule, as carefully finished as a piece of parlor furniture, and where a bright metal may be used to improve the general appearance, without excessive cost, it is invariably utilized.

A well-known American manufacturer, recently settled in Berlin, told me that it was impossible for him to sell machinery in Europe finished as he had formerly turned it out in New York. "I have got to put frills on it," he remarked, "or they won't buy it." I inquired as to the cost of putting on the frills, to which he replied: "Oh, it is very small; I suppose one-eighth of one per cent of the total cost of the machine will cover it." I followed this subject up somewhat with other manufacturers, and I reached the conclusion that in no case would the cost of the change in finish exceed one per cent of the total cost.

Another objection urged to the importation of American machinery, which I found almost universal, related to the absolute carelessness of American manufacturers in packing machinery. "In many cases," said a manufacturer to me, "the machines come to us broken or so poorly packed that they are bent or injured. Your manufacturers do not seem to have any system of packing, and no directions accompany the goods descriptive of how they should be unpacked and set up." In Europe it is the practice to pack goods very carefully and to attach a ticket to each part, even to the smallest screw, such tickets bearing a number, and accompanying the package a statement of how the goods shall be unpacked, directions for the order of setting up, etc., etc. I inquired the cost of this, to which the manufacturer replied: "It costs a good deal less than to replace parts broken in transit."

If the American manufacturers intend to compete successfully in the European and Asiatic markets, they will find that it is necessary to pay attention to the requirements to which I have called attention.

ELECTRIC RAILWAYS.

Gross passenger receipts of the West Chicago Street Railroad for the year (the last ten days of December being estimated) show an increase of $292,715, or more than 7 per cent as compared with 1898. North Chicago's increase amounts to $125,399, or a little more than 4 per cent. The two roads together, now comprising the Union Traction system, show a gain for the calendar year of about $420,000, or 6 per cent, of which about $270,000 was made in the last six months.

A settlement has been effected in the case of the present owners of the Pittsburgh & Birmingham Traction Company against H. Sellers McKee, Murray A. Verner, Pittsburgh, and E. W. Clark & Company, Philadelphia, in which the plaintiffs sued to recover $1,000,000 alleged to have been wrongfully spent by the defendants in changing the power of the Birmingham Company from horses to electricity. It was alleged in the bill that the defendants diverted a large sum to themselves.

By a unanimous vote of the board of directors of the St. Charles Street Railroad Company, New Orleans, comprising the Baronne and Carondelet, Dryades and Rampart, and Clio and Erato lines, it was decided to present all the employés of the road, conductors, motormen, trackmen, linemen, electricians, and, in fact, every single one of their employés with a Christmas gift. The company presented to the employés the entire proceeds or gross receipts of the three lines of cars on Saturday and Saturday night, share and share alike to all.

The Joliet Street Railway Company has been sold to the American Street Railway Company, one of the largest street railway syndicates in the United States. The Joliet system has twenty-two miles of tracks, which run through the main business parts of the city and to Rockdale and Lockport. The amount paid for the road was $500,000, and the transfer was made on December 30. The new company will build several new lines in the Spring and will extend the line to Chicago by way of Lemont and Archer avenue. The company has a 50-year franchise in Joliet, Ill.

If present plans are carried out, it may not be long before a through electric line is operating between Erie, Pa., and Cleveland. The Jefferson & Andover Electric Railway Company is said to be promoting the scheme. The president of that company is said to have secured options in Conneautville and Springboro, Pa. The route of the line is to be from Jefferson, by way of Pierpont, to Conneautville, thence by way of Springboro, Shadeland and Albion to Edinboro. The preliminary surveys are said already to have been made. It is stated that rights of way have been secured to the Ohio state line.

The rumor that the directors of the Pittsburgh, Pa., and the Castle Shannon Railway Company had authorized the sale of its road to one of the Pittsburgh traction companies is denied by the officials of the concern. It is said the story first came from one of the stockholders, who claimed the road was not doing as good business as was desired and that negotiations for its sale were under consideration. The plan included the purchase of the West End traction lines by the Consolidated Traction Company, to form a complete belt line around Duquesne Heights, Mount Washington and Birmingham.

The Cincinnati & Hamilton Electric Street Railway Company has begun a movement which, if successful, will have a far-reaching effect. It is now engaged in securing consents of property owners along the streets not traversed by any other street railway, whereby it proposes, by three distinct loops, to bring large portions of territory in the outlying districts of the city into direct connection, through its several branches, with its main line. It is the intention to extend one line to East Hamilton, a second to the Butler County Fair Grounds and the Catholic cemetery, and a third through the Prospect Hill division, in the First Ward. All of these districts are thickly populated, and the branch lines will afford the largest facilities for public travel. The scheme involves the construction of about ten miles of additional tracks.

The first legal step toward uniting the property of the Chicago Consolidated Traction Company has been taken by the sending out of a circular to all stockholders of the former company announcing the terms on which the change of control would be effected. The circular notified the stockholders that they could turn in their stock and receive in exchange the bonds of the Chicago Consolidated Traction Company, guaranteed by the Chicago Union Traction Company. The Chicago Consolidated Traction properties are located in the north and northwest parts of the city and suburbs. The lines were built under the Yerkes management as feeders for the North Chicago Street Railroad Company and the West Chicago Street Company, and Mr. Yerkes retained control of them when he sold out his other surface interests in the Chicago Union Traction Company.

Wall Street and the Electrical Stock Market.

The year in the stock market which closed with this week was one of the most turbulent in the history of the New York Stock Exchange. Speculation in securities has been upon an unusually large scale, and fluctuations in values have been particularly severe. Protracted and sudden rises in values and a series of collapses in prices marked the year. The public exhibited unusal interest in the market, chiefly upon the revival of the country's trade and the exceedingly low rates for money which prevailed up to the close of the year. The outlook for the approaching year is not exactly clear. The action of Congress and the Anglo-Boer war are indeterminate factors at the present time, and later on the agricultural situation, with all of its uncertainties, must be taken into account. Experts in Wall street prophesy that 1900 will be a period of adjustment and solidification of values.

On the New York Stock Exchange General Electric closed the week and the year at 122½ bid and 123½ asked, a gain for the week of 5 points. This stock closed the year 1898 at 95¾ and reached its highest price, 132, during 1899. Metropolitan Street Railway, of New York, closed the week at 175¾ bid and 175⅞ asked, a gain of 18⅜ points for the week. This stock closed the year 1898 at 191¾, and during 1899 reached 269. Third Avenue Railroad, of New York, closed the week at 131½ bid and 132 asked, a gain of 4½ points for the week. This stock closed the year 1898 at 167 and reached 242 during the current year. Brooklyn Rapid Transit closed the week at 72¼ bid and 72⅜ asked, a gain of 3⅝ points for the week. This stock closed the year 1898 at 74 and reached 137 during 1899. Manhattan Railway, of New York, closed the week at 96½ bid and 97 asked, a gain of 7 points for the week, having closed the year 1898 at 97¾ and reached 123⅜ during 1899.

On the Boston exchange American Bell Telephone closed the week at 341 bid and no asked price, indicating no change in the bid price for the week. Erie Telephone closed at 100 bid and 101 asked, showing no change for the week.

On the Philadelphia exchange Electric Storage Battery closed at 80 bid and no asked price, a gain of five points for the week. Union Traction closed at 38⅜ bid and 38½ asked, a gain of 3¼ points for the week. Electric Company of America closed at 13⅜ bid and 13½ asked, a gain of 2 points for the week.

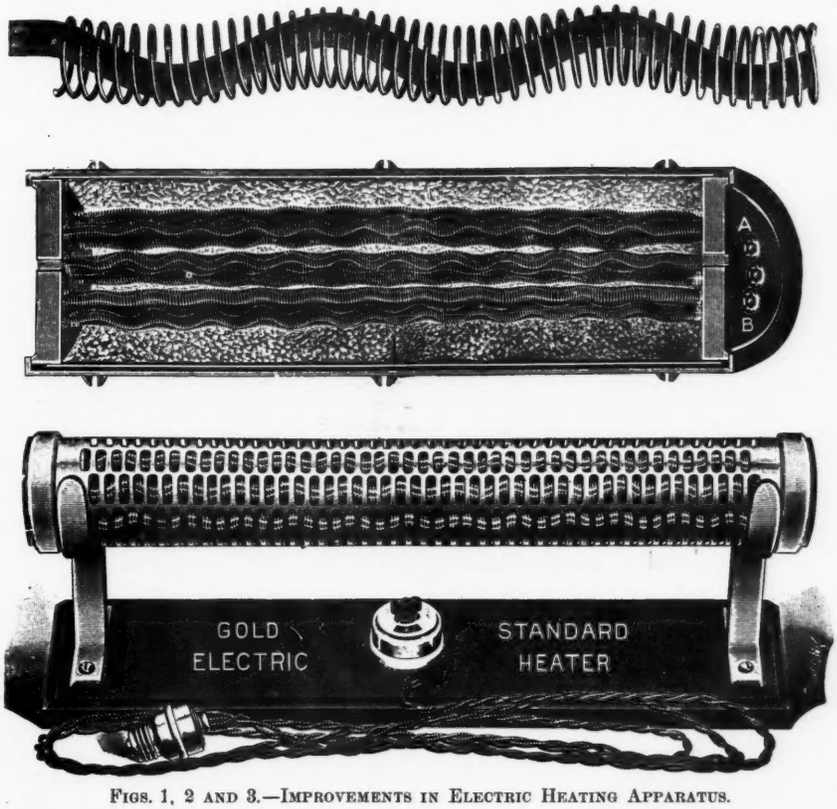
Wall Street, December 1899, 30.

Improvements in Electric Heating Apparatus.

The new and improved electric heater recently placed on the market by the Gold Car Heating Company, of Frankfort and Cliff streets, New York city, has attracted considerable attention in the street-railway field, and has been adopted by many street railways throughout the country. The advantages of the new heater over the old style are several. The design is handsome, and the form is compact, providing for the necessity of smaller space in the general run of street cars. The resistance coils are arranged in such a way that the support itself, while holding the wire firmly in place and not permitting vibration, will offer the smallest possible amount of resistance to the flow of air through the heater. This support consists of a one-quarter-inch steel rod, which is thoroughly covered with an insulating enamel, which is burned on the rod at over 2,000 degrees temperature. It is therefore not affected by any heat to which it will ever be subjected, and is, at the same time, an absolute non-conductor. This rod is shaped in a zig-zag form, and the resistance coil is slipped on over the rod conforming to its shape. By this construction the wire is evenly heated over the entire surface, and always maintains its original and natural condition. In the event of a wire breaking, it would be held fast on the supporting rod.

The interior of this heater, as shown in Fig. 2, is lined with asbestos, and has an air space provided at the top, which prevents the back of the heater case from becoming unduly heated. The ends of the enameled supports are fitted into solid porcelain blocks. The resistance coils are connected to the binding posts on the inside of the porcelain ends, and from the outside terminal of the binding posts connection is made direct to the adjacent heater. This heater has the coils so arranged that the upper sets are in multiple and the lower sets in single series. The regulating switch of the heater is very simple in construction and of great durability. The materials used in the several parts of the heater are all separately tested to a high degree before being assembled.

The company is also manufacturing many styles of heaters for different uses. The accompanying illustration, Fig. 3, shows a heater supported on a cast-iron base and made up complete with cord and plug attachment. The switch on the base is for the purpose of controlling the current. Several heaters for dwellings, office buildings, steamships, etc., are being manufactured as shown in Fig. 4, which is a portable type fitted with a three-point switch, making it possible to have three graduations of temperature. This heater has a very handsome and ornamental finish.



FIGS. 1, 2 AND 3.—IMPROVEMENTS IN ELECTRIC HEATING APPARATUS.

PERSONAL.

Mr. Morris W. Mead, chief of the Electrical Bureau, of Pittsburgh, visited New York city last week.

Mr. H. L. Shippy, secretary of the John A. Roebling's Sons Company, returned to New York city last week after an extended trip to Europe.

Mr. L. P. Smith, of the Ericcson Telephone Company, was married to Miss Julia M. Lillard in New York city, on December 27. Miss Lillard is the daughter of Benjamin L. Lillard, publisher of *Popular Science.*

FIG. 4. ELECTRIC HEATING APPARATUS.

Mr. C. E. Corrigan, of Chicago, who is well known as the general manager of the American Electric Vehicle Company, of Illinois, has removed to New York city, where he will hereafter make his residence. As noted elsewhere in this issue, the above company has been acquired by the American Electric Vehicle Company, of New Jersey, with offices in New York city. Mr. Corrigan has assumed the vice-presidency and general management of the new company.

Wireless Telegraphy a Failure in South Africa.

A press cablegram states that the London *Daily Mail's* Cape Town correspondent says that the experiments with the Marconi system of wireless telegraphy between DeAar and Modder River have met with small success, the iron in the hills beyond Enslin playing all sorts of pranks with the system.

The Goshen, Ind., and Elkhart independent telephone systems are to be consolidated. Both home companies are thoroughly equipped and are said to be as strong as the competing Bell exchanges. The incorporation papers have been prepared and will be filed at Indianapolis. The consolidated company will be known as the Home Telephone Company of Elkhart County. It is intended to eventually include all the independent lines of the county.

Big Electric Light and Power Deal In New York City.

It was announced on January 3 that the Consolidated Gas Company, of New York city, had acquired an interest in the New York Gas and Electric Light, Heat and Power Company, which owns the local electric light and power companies in the Borough of Manhattan. This means that the Whitney-Widener-Elkins interests have effected an alliance with the Rockefellers, as far as the combination in question is concerned. It was also rumored that the Consolidated Gas Company had acquired control of the Kings County Electric Light and Power Company, of Brooklyn, N. Y., but this is not believed to be the case at the present time. The annual meeting of the latter company occurs on January 8.

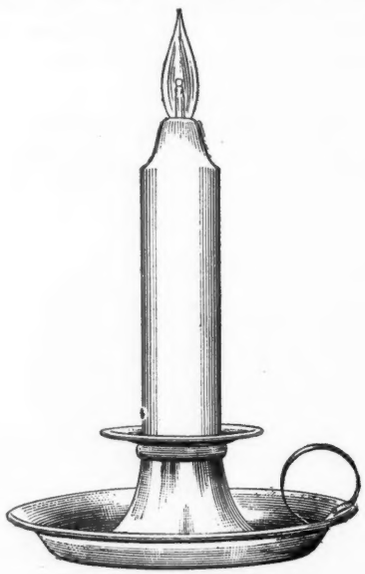
The New York Gas and Electric Light, Heat and Power Company was formed in November, 1898, with a capital of $25,000,000, which was increased later to $36,000,000. The properties and companies it purchased included the subways of the Consolidated Telegraph and Electrical Subway Company, a half interest in the Empire City Subway Company, and the following electric lighting companies: Mount Morris Electric Light Company, North River Electric Light and Power Company, New York Heat, Light and Power Company, Yonkers Electric Light and Power Company, Borough of Manhattan Electric Company, Block Lighting and Power Company, Manhattan Electric Light Company, Edison Electric Illuminating Company, of New York, and the United Electric Light and Power Company.

Electric Pumping Station at the New York Navy Yard.

Captain P. C. Asserson, civil engineer of the Brooklyn Navy Yard, has prepared plans which have met the approval of the Secretary of the Navy for an underground electric pumping station for Drydock No. 1, costing about $40,000. The station will be underground in order to save space in the Navy Yard, which every year is getting more valuable. It will be located at the head of stone Drydock No. 1, and will replace the old and antiquated station which was built in 1854. Centrifugal pumps, operated by electricity and having a capacity of throwing 30,000 gallons of water out of the drydock a minute, will be installed, and 350 horse-power electric motors will be used to operate the pumps. When the new plant is completed the dock can be emptied in one-third of the time now required and at one-half the cost. It will take five months to build the new pumping station. The funds for its construction will have to be furnished by Congress.

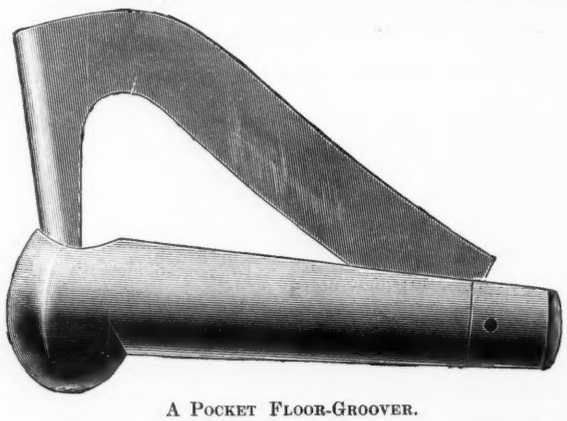
Portable Battery Lamps.

The increasing demand for lamps that are perfectly safe for use in dark corners, closets, and so forth, has brought out an electric candlestick that is said to be of greater efficiency than anything of the kind heretofore sold. This candlestick is made by the United States Battery Company, of New York, and is a model of an old Dutch brass candlestick, the candle



A Portable Battery Lamp.

part being enameled to make an exact imitation of a candle. In place of the flame is an incandescent bulb which gives forth a clear, bright light, which is much more penetrating than that of a candle flame. This light is furnished by a pair of small storage batteries which are inexpensive and which can be recharged from a direct electric current.



A Pocket Floor-Groover.

The whole affair is very simple, and can be handled by a child, as there are no wires nor machinery of any kind. It does away with all dirt, heat, smoke, odors and the usual trouble of an ordinary oil lamp, and should prove a great convenience to users. It is not a mere novelty, but is evidently intended for use, and is, also, artistic in form. It seems to follow in line with the utilitarian quality of all the portable lamps made by this company. It stands about ten inches high, and the base diameter is about seven inches.

American Electric Vehicle Company.

The American Electric Vehicle Company, of New Jersey, was incorporated on December 29, with a capital stock of $5,000,000, by Messrs. J. Herbert Ballantine, of Newark, N. J.; Miles Tierney, president of the Hudson Trust and Savings Bank, Hoboken, N. J.; George T. Lister and George B. Hurst. This company has purchased the patents and assets of the American Electric Vehicle Company, of Illinois, and other patents, including several for an improved type of Planté storage battery. The company will establish at once general offices, a repository and a charging station at a convenient location uptown in New York city. A large factory is now in operation in Hoboken, N. J., and the company is building on its own ground a larger manufacturing plant in Newark, N. J. The directors of the company are J. Herbert Ballantine, president; C. E. Corrigan, vice-president and general manager; George T. Lister, secretary and treasurer; Miles Tierney, Percy Ballantine, G. B. Hurst, Henry W. Young, Jr., H. G. Osburn and J. D. Adams.

A Pocket Floor-Groover.

The Western Electric Company, Chicago, is placing upon the market a new floor-groover, the blade of which is very similar in appearance to the stiff-handled floor-groover which has been used for some time.

A novel and peculiar feature of this tool lies in the fact that the blade can be folded back into the handle like the blade of a pocket-knife. The point fits into a socket, the edge of which comes in contact with the back of the floor-groover, thus preventing the point from being worn. When folded, the greatest dimension is three and one-quarter inches and can be carried handily in the pocket. Or, if the tool is thrown into the handbag of the workman with other tools, the point is protected by the socket into which it fits, thus making it impossible for the other tools to spoil the edge. The handle of the floor-groover is made of brass, and is of a convenient size and shape which fits the hand. The illustration shows the floor-groover closed.

Federal Battery Salt.

The Federal Battery Company, of New York, who manufacture Federal salts, report a large and rapidly increasing demand for their goods, and invite a thorough examination of their claims. They have reports from large telephone and railroad companies, which attest the merits of these salts.

The following announcement from the company has just been received:

Sal ammoniac has held the field so long as a battery excitant for small cells of various kinds that anything different becomes at once an object of interest to electricians.

Federal salt and Federalite is being vigorously pushed to replace sal ammoniac, and its advantages are quickly recognized by large users of batteries all over this country and in Canada. The fact that no crystals or creeping salts are formed is in itself an immense advantage. Few people stop to consider why their batteries are constantly getting weaker and weaker, and fewer still lay the blame where it belongs. When a sal ammoniac solution is used the hard oxychloride crystals form on the carbon and zinc, which lessens the active surface, and the battery becomes less able to stand the work which when new it was able to accomplish. The recuperation therefore becomes slower, and the efficiency is at least a third less from this cause. Federal salt and Federalite form no crystals or creeping salts whatever under any conditions. In addition to this, these salts contain an active soluble depolarizer, which enables the cell to recover in a remarkably short time after being short-circuited.

The electro-motive force of a battery using Federal salt or Federalite is higher than sal ammoniac, and the current is practically constant during the life of the cell. This is due to the soluble zinc salt formed, which is a better conductor than the original solution and to the higher heat units of the salts used.

The following is an extract from report of batteries charged with Federal salt after seven months' telephone service, the test having been made by the Southern New England Telephone Company:

Our batteries were charged with Federal salt on February 1, and at time of test had been in use for seven (7) months and are still in service.

There is no crystallization or creeping salts on the cells at time of test.

The readings were taken when the telephone hook was off, reading every minute for five (5) minutes. The hook was then returned, and the recuperation readings taken every minute also for five minutes.

Test was made at the same time on new Leclanche cells charged with sal ammoniac, and only used for this test.

The readings of one 'phone of forty (40) in service are given below, as well as the new sal ammoniac cell under the same test. Three (3) cells on 'phone in both tests.

Federal Salt Discharge.			Federal Salt Recuperation.		
0 Minutes		4.30 Volts.	5 Minutes		4.25 Volts.
1	"	4.20 "	4	"	4.25 "
2	"	4.15 "	3	"	4.23 "
3	"	4.05 "	2	"	4.22 "
4	"	3.95 "	1	"	4.20 "
5	"	3.90 "	0	"	3.90 "

Zincs eaten about one-third after seven months on 'phone.

Sal Ammoniac Discharge.			Sal Ammoniac Recuperation.		
0 Minutes		4.24 Volts.	5 Minutes		3.55 Volts.
1	"	3.10 "	4	"	3.43 "
2	"	2.40 "	3	"	3.20 "
3	"	2.10 "	2	"	2.91 "
4	"	1.95 "	1	"	2.62 "
5	"	1.90 "	0	"	1.90 "

Meeting of Independent Telephone Manufacturers In New York City.

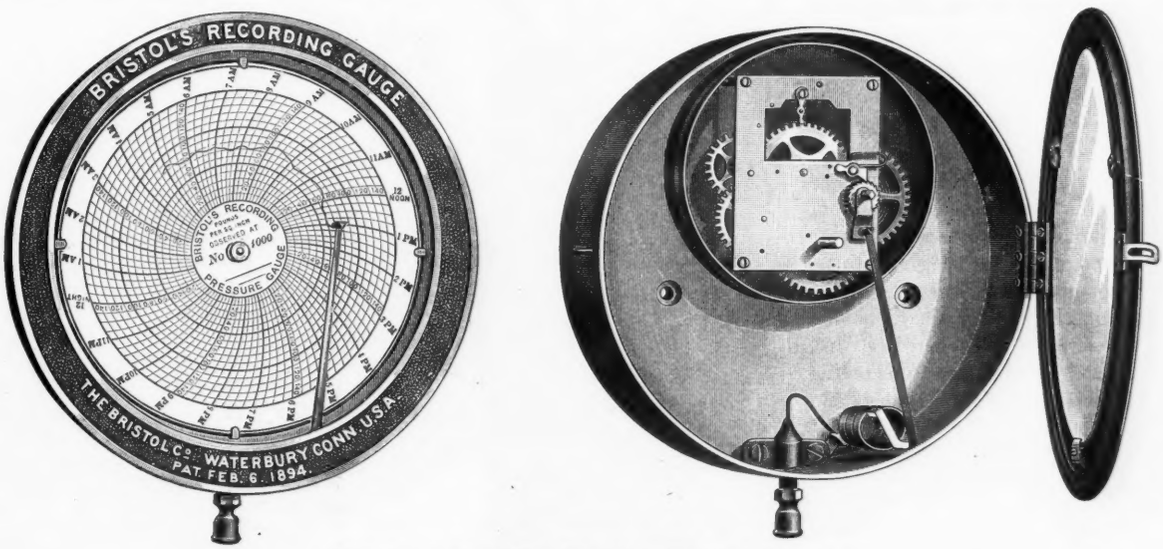
Representatives of practically all the independent telephone manufacturers in the United States, met in New York city, on January 4, at the office of a lawyer who is said to represent Mr. Charles R. Flint. The object was to form a working alliance between the various manufacturers, and to devise means for closer relations with the independent operating telephone companies. No final results were accomplished, and the meeting adjourned to January 8.

A New Recording Pressure Gauge.

The illustrations, Figs. 1 and 2 herewith, show exterior and interior views of a new round recording pressure gauge that is being placed on the market by the Bristol Company, of Waterbury, Ct.

This new form has been designed to meet a demand for a recording gauge at a lower price than the standard gauges, which have, during the ten years they have been in use, acquired a high reputation for accuracy and durability.

A special feature of the round form is that the dial is located slightly eccentrically to the main body of the case, thus allowing sufficient space on the lower side of the dial for the pen arm to pass out between dial and the case.



FIGS. 1 AND 2.—A NEW RECORDING PRESSURE GAUGE.

Fig. 1 shows the exterior of the gauge, complete and ready for application. Fig. 2 shows the interior construction of the instrument, and the extreme simplicity upon which its accuracy and durability depend to a large degree. The pen arm is directly attached to the free end of a tube of flattened cross-section, which is bent into a helical form.

The tendency of pressure applied is to straighten or uncoil the helical tube, which causes the pen arm to move over the range of the chart without the necessity of any intervening multiplying devices.

In order that the advantages of using recording pressure gauges and other recording instruments may be more generally appreciated, the Bristol Company are filling orders for these instruments, with the privilege of returning at the end of 30 days' trial if not perfectly satisfactory.

Mr. Herbert A. Wagner, general superintendent of the Missouri Edison Electric Company, of St. Louis, Mo., visited New York city last week.

TELEPHONE AND TELEGRAPH

The stock of the American Telephone and Telegraph Company, a New York corporation, as substituted for that of the Bell Telephone Company, a Massachusetts corporation, is not locally taxable to stockholders living in Massachusetts, so long as the American Telephone and Telegraph Company shall operate in New York.

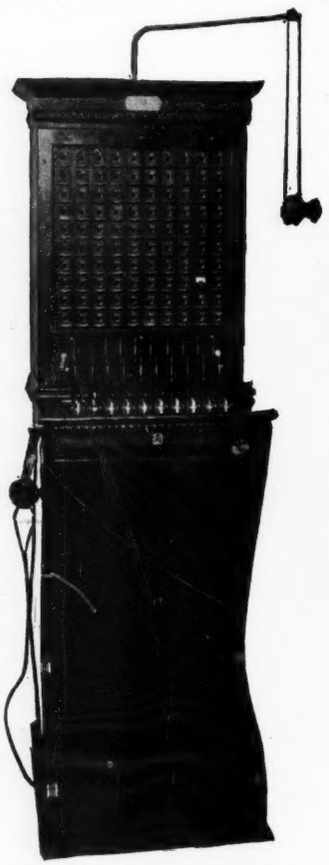
The Wisconsin Telephone Company will at once put several large crews of men at work in Fond du Lac, building additional lines. Within a year the Wisconsin will have 2,000 'phones connected and working in Fond du Lac. A large cut in prices for service is very likely to be made to meet the prices of the Little Wolf River Company.

United States Circuit Judge Nathan Goff has rendered an opinion, in which he takes the ground that if the Southern Bell Telephone and Telegraph Company, as decided by the United States Supreme Court, has no right upon the streets of Richmond, under an act of Congress passed in 1866 regarding telegraph lines, it has no right under the laws of Virginia or the ordinances of the city of Richmond to use such streets. He, therefore, will, at a later date, issue a decree dismissing the bill of the complainant company and dissolving the injunction restraining the city from removing the poles and wires of the Bell company from the streets of Richmond.

The Supreme Court of Columbus, Ohio, handed down a decision that will result in bringing the state a revenue of about $80,000 per annum from the Bell Telephone Company. The case is that of Ohio *ex rel.* the Auditor of State against the attorney of Franklin County in mandamus. The case is decided in favor of the relator. The County Auditor was instructed to place the telephones in that city on the tax duplicate according to their earning values, which was refused, when the mandamus proceedings were commenced to compel him to comply with instructions. The decision is based on a decision made by the Supreme Court of the United States on what is known as the express case, where it was held that the earning power of property was the true valuation where protected by patents.

A meeting of the managers of the independent telephone systems of Southwest Missouri and Southeastern Kansas was held at Galena, Mo., recently. It was the preliminary step looking to the establishment of a long-distance system, extending from Joplin to Kansas City and to Springfield, the toll charges to be a uniform rate of 25 cents between all towns along the system. At the meeting Joplin, Galena, Carthage, Neosho, Peirce City and Girard were represented. G. W. Crawford, of Girard, was made temporary chairman, and George R. Armstrong, of Pierce City, secretary. The matter of improving the service of independent lines between all points to be connected was discussed, and it was decided to hold another meeting in Joplin on January 16, when a permanent organization will be effected.

The board of directors of the Rocky Mountain Bell Telephone Company met recently and passed a resolution authorizing the president to call a meeting of the stockholders to increase the capital stock to the figure required by the extensions and improvements proposed during the coming year. It may be stated that the value of the improvements proposed will aggregate close to $600,000. The scope of operations of the telephone company extend 1,000 miles east and west, and 1,000 miles north and south, from Salt Lake City, Utah, and not only are the lines within this limit being multiplied, but under the new plan of operations the wires will be extended considerably further, including the proposed wire through southwestern Utah and southern Nevada to the California line to connect with the Southern California Telephone Company to Los Angeles and San Diego. The board also recommended certain real estate improvements, that a reduced rate be given to hospitals receiving free patients, to charitable institutions, to religious bodies and to schoolhouses.



A NEW TELEPHONE SWITCHBOARD.

A Novel Telephone Switchboard.

A telephone switchboard, in order to give satisfactory service, must comply with certain fundamental principles, the most important of which are the following: Simplicity in construction, rapidity of operation, accessibility of parts and the elimination of crosstalk caused by induction or poor insulation. A 100-drop board embodying the above-mentioned features is shown in the accompanying illustration, a brief description of which is as follows:

The cabinet is made of thoroughly seasoned, selected, quarter-sawed oak, strongly made and finely finished. The cords, house cable and all connections are made on the inside of the back of the cabinet, which is fitted with double doors provided with lock and key so that no injury can occur to these parts.

The drops and jacks of the self-contained type are mounted on hard rubber and are held in position each by a single nut. They are interchangeable and so constructed that the necessary connections, except line connections, are automatically made when the jacks are placed in position in the board. The night bell contacts are positive, being made on the rubbing principle and are substantial and provided against injury. The board is operated by means of cams for listening, and the ringing of a subscriber is accomplished at the same time the plug is placed in the jack of the party wanted. The shutters or drops are practically automatically self restored when a plug is placed in a jack or removed from the same.

The listening cams are placed in a dustproof case and can easily be inspected at any time by raising the lid of the camcase, on the underside of which they are mounted. The magnet windings are very novel in construction, the necessary wire being wound in the form of a helix, which is slipped into its case upon the removal of the magnet armature and a fibre retaining disk; thus a burned-out drop can be renewed in a few moments without the necessity of returning it to the factory. The operator's receiver and transmitter are of the latest improved type and are both adjustable in all directions.

A very important point in this board is the fact that it can be used either for strictly metallic circuits or common return or ground circuits with no change except connecting one side of each drop terminal to the common return or ground wire; thus a common return system using this board can be changed over to metallic, or vice versa, with practically no expense as far as the board is concerned.

This board is made up in all sizes from 1,000 to 2,000 drops, and the drops are mounted in several types of cabinets. This apparatus is the result of years of careful study and experiment by the Connecticut Telephone and Electric Company, of Meriden, Ct., who manufacture it exclusively, and who will be glad to furnish additional information to any one interested.

A Central Energy Telephone System and Multiple Switchboard at Parkersburg, W. Va.

One of the greatest developments in Independent telephony is the multiple switchboard, in connection with the central energy system, one of which has recently been installed at Parkersburg, W. Va.

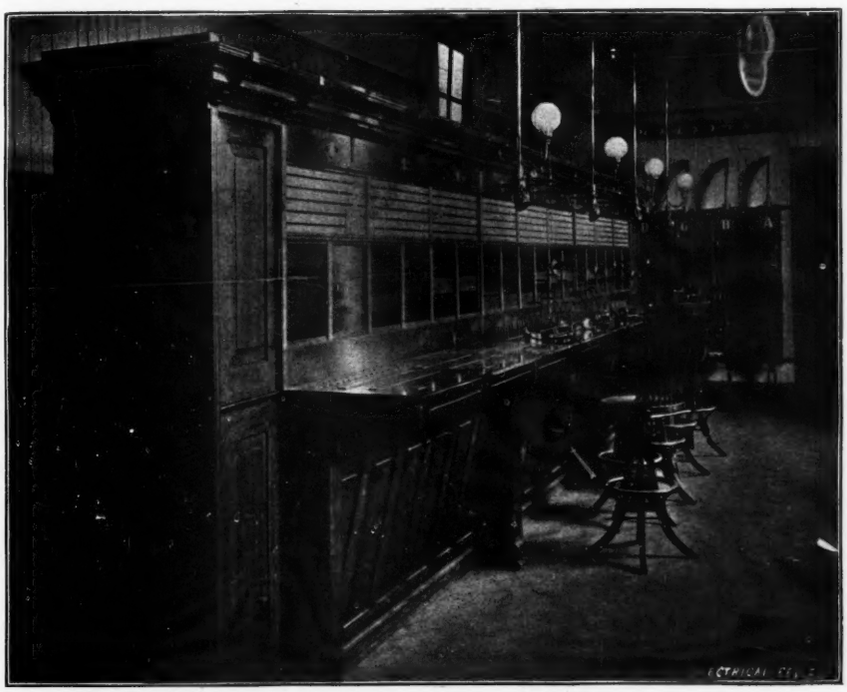
The company at Parkersburg is one of the oldest and largest Independent companies in the country, its lines covering and connecting with several thousand miles of toll-lines and a large number of exchanges.

The exchange was installed under the most adverse circumstances and with but few contracts for subscribers; it was difficult to secure subscribers before work was begun, owing to a number of previous unsuccessful attempts to establish an exchange in that city. Before starting the work, the company thoroughly investigated a large number of exchanges outside of its own and every make of apparatus, and decided on sparing no expense in putting in a plant of the best possible grade.

The outside line-construction is copper metallic throughout, using a large amount of cable furnished by the John A. Roebling's Sons Company. The work is done in the most substantial manner and the apparatus is that of the central energy system and multiple switchboard manufactured by the Stromberg-Carlson Telephone Manufacturing Company, Chicago.

The switchboard shown in the illustration is built with a capacity for 1,800 subscribers. The exchange opened with 500 subscribers and is rapidly increasing, and is reported to be one of the best working exchanges of its size now in operation.

The subscriber signals the central by taking the receiver from the hook and throws the "disconnect" signal when replacing the receiver. All the battery power and ringing energy is supplied from the central office. In the multiple board each operator is within reach of any line in the exchange, enabling any one operator to complete any connection received. The line signals are automatically restored when inserting the plug, and the clearing-out signals are automatically restored when disconnection is made. The line and clearing-out signals are given and restored electrically.



CENTRAL ENERGY MULTIPLE SWITCHBOARD AT PARKERSBURG, W. VA.

This is considered to be one of the most convenient boards now in use. The battery power for the entire exchange being furnished from one set of batteries at the central office, leaves very little cause for inspecting subscribers instruments, which greatly reduces the maintaining expense and makes the system not only far more convenient to the user than the ordinary local battery and generator call system, but far more economical to the exchange owner. The success of this system is of great interest, especially to Independent telephony.

Among those most prominent in the company are J. H. Grogg, of West Union; C. E. Haddox, Petroleum; J. H. Lininger, Harrisville; R. H. Rutherford, Cairo, and Levin Smith, Parkersburg, W. Va.

The New England Telephone and Telegraph Company has just completed the installation of a long-distance telephone line between Poultney, Vt., and Middletown Springs.

PROGRESS OF THE GENERAL ELECTRIC COMPANY IN 1899.

BY S. DANA GREENE.

We are glad to be able to say that our business has shown a very material increase over last year. This is due partly to the increased prices which have been made necessary on account of the abnormal advances in the price of raw materials, amounting on some important items, such as sheet-iron, to about 100 per cent advance. While there seems to be no evidence at the present time that prices of raw material will show any marked decline during the coming year, we believe, nevertheless, that raw material costs (and therefore prices) have reached the high-water mark.

Local companies are paying more and more attention to economies of operation both inside and outside of their stations, and to intelligent methods of charging customers for current consumed, with the result that there have been many plants during the past year which have thrown out old and obsolete apparatus and supplies, and installed modern appliances in their place. There has been, as you are undoubtedly aware, a very marked advance made in the general introduction of enclosed arc lamps, both for commercial and street lighting purposes, on alternating and direct currents, and this progress bids fair to be equally advanced during the coming year.

Apart from the constantly increased sizes of machines, there have been no radical changes during the past year in methods or systems of installation and distribution.

In electric railroad work the tendency toward larger and heavier cars and higher speeds (with correspondingly larger and more powerful motors) is very marked, and many steam roads are now giving serious attention to the problem of the electrical equipment of branch lines. It is an interesting fact that in such installations the electrical apparatus forms about 20 per cent only of the total cost of equipment. In fact, this percentage is true for any large central station, the land, buildings, boilers, engines, etc., outside of electrical machinery, amounting to about 80 per cent of the entire expense.

J. E. Farnsworth, superintendent of the Southwestern Telegraph and Telephone Company, has offered a reward of $100 for the person or persons who cut and carried away a large piece of their copper wire, four miles west of Dallas, on the night of the 13th ult. Local officers have been advised of the reward. A standing reward of $50 is offered for any person caught tampering with the wires of the company.

INDUSTRIAL NOTES.

The North Electric Company, Cleveland, Ohio, is manufacturing an excellent line of telephone instruments for all characters of service and also switchboard apparatus of the most modern and approved designs.

The Electric Appliance Company, Chicago, report that one of the largest packing houses in the country, after a severe test of all makes of wires, has adopted their Paranite rubber-covered wire, for the entire installation.

T. H. Brady, New Britain, one of the pioneers in the electrical field, will send to applicants catalogues giving descriptions and prices of mast-arms, pole and swinging hoods, arc and cutout boxes, fuse boxes, knife switches, brackets and hanger-boards.

The Speer Carbon Company, St. Marys, Pa., is having excellent success in the introduction of the Speer self-lubricating motor brush. It is generally known that Mr. J. S. Speer, of this company, was for many years a manufacturer of carbon brushes at Sandusky, Ohio.

The Hays Construction Company, Davy Block, Troy, Ohio, is organized on a large scale for engineering and contracting work along electrical lines. This company is prepared to remodel unprofitable light and power stations. Its unique motto is "You furnish the plant, we make it pay."

Hugo Reisinger, 11 Broadway, New York, is the sole importer of the "Electra" carbons for direct and alternating-current long-burning open and enclosed arc lamps. These carbons are claimed to produce an absolutely steady and brilliant light, and to be of the highest quality and efficiency.

Hart & Hegeman Manufacturing Company, Hartford, Ct., illustrates in this issue a number of the Hart switches, showing the complete variety in which they are made. This company will be glad to send on application, a voluminous catalogue, well illustrated, descriptive of Hart switches.

The Crown Woven Wire Brush Company, Salem, Mass., in connection with the Crown woven wire dynamo brushes, which have been on the market for many years, are introducing a new commutator compound which accomplishes excellent results, known as the "Crown" commutator compound.

The Cutler-Hammer Manufacturing Company, makers of high-class rheostats, inform the ELECTRICAL REVIEW that, since their removal from Chicago to Milwaukee, their business has increased to such an extent that a three-story addition is being constructed, which will be ready for occupancy in two months.

"P. & B." has been for many years associated with the highest grade of insulating compounds as manufactured by the Standard Paint Company, of New York, Chicago, Hamburg and London. This company's products for electrical purposes include armature and field-coil varnish, insulating tape and ruberoid motor cloth.

The Onondaga Dynamo Company, Syracuse, N. Y., has just taken possession of its new building known as the Phelps Block It has been constructed along the most modern factory principles for manufacturing electrical machinery. Its equipment includes power furnished by gas engines, a traveling crane, telephone system and every facility possible.

The Warren-Medbery Company—Judge Stover, of Amsterdam, N. Y. has appointed Mr. Grenville M. Ingalsbee temporary receiver of the Warren-Medbery Company, manufacturers of dynamos, of Sandy Hill, N. Y. Mr. H. J. Medbery informs the ELECTRICAL REVIEW that he withdrew from the company about a year ago, and has had no connection with it since.

Zimdars & Hunt, 127 Fifth avenue, New York city, are manufacturers of high-grade electrical specialties, including switchboards, knife switches, panel-boards, feeder and main - boards, voltmeter switches, automatic switches, lugs and connections A catalogue, with discounts to the trade, may be obtained, postage free, by applying at the address above.

The Manhattan General Construction Company, Newark, N. J., and New York city, reports a factory full of orders for the alternating-current series enclosed arc system. This Manhattan system of arc lighting achieves splendid results in power factor and efficiency, such as would appeal, on a practical basis of accomplishment, to discriminating electrical engineers.

R. B. Corey, Havemeyer building, 26 Cortlandt street, New York city, has accepted the agency for the line of switches made by the Hart & Hegeman Manufacturing Company. Mr. Corey, in addition, is the selling representative for the Simplex Electrical Company, Bossert Electric Construction Company, Columbia Incandescent Lamp Company and the Boston Electroduct Company.

The Jandus Electric Company, of Cleveland, Ohio, manufacture enclosed arc lamps for out-door and inside service. The lamps of this company possess few working parts and are among the quickest lamps to trim. They give uniform distribution of light and are noiseless and do not flicker. The "Jandus" is very popular with all users of arc lamps who have ever given it a trial.

The Hart Manufacturing Company, Hartford, Ct., calls special attention to the "Diamond H" push switches and their method of construction, inasmuch as sheet mica insulation, as a preventative of absorption of moisture and burning out, is used. This company is making a large line of switches and specialties of this character, and has recently gotten a new catalogue from the press.

The Eddy Electric Manufacturing Company, of Windsor, Ct., is one of the earliest of the motor manufacturing companies of the United States, and its motors and generators are made in standard types and sizes, both for belt driving or direct connection. The company is one of the foremost in its field, and is building at the present time a modern vehicle motor that is interesting all owners of automobiles.

The New York & Ohio Company, Warren, Ohio, has recently published a booklet on "Transformers and Their Profitable Use," by Dugald C. Jackson, C. E. The booklet also contains a description of the Packard transformer. This company has for 11 years manufactured the well-known Packard incandescent lamps. It also makes the "Mogul" lamps in candle-powers from 200 to 1,000.

The Couch & Seeley Company, Boston, Mass , are manufacturers of telephones, switchboards and everything relating to telephone exchanges and private lines; it also makes the "W. & C." coal grain microphone bipolar receiver. The aim of this company is to produce only the highest grade of telephone apparatus, employing the best quality of material and the most skillful labor for the accomplishment of this end.

Schiff, Jordan & Company, 232-4 Greenwich street, New York, have received very heavy importations of "Ship" carbons for arc lighting during the past few weeks. These carbons are claimed to be the very highest grade manufactured in the world, and are all made in the Vienna, Austria, factories of this company. Through its New York office this company is now handling a general line of electrical supplies and specialties.

The "Buckeye" Incandescent Lamp, made by the Buckeye Electric Company, Cleveland, Ohio, with branch offices in all the large cities of the country, is said to be produced in the second largest quantities of any incandescent lamp in the world. During the past year this company has almost trebled its factory production and, even with these increased facilities, according to the president, Mr. J. Potter, it has been taxed to its utmost capacity.

Dollars Cut in Two is not the title of a little folder just issued by the Central Electric Company, Chicago, although it is stated that the prices named on small power motors and ventilating fans would justify this title. This house states that less than factory costs are named on the above machinery because of a change in agencies, and any one wishing to buy at bargain prices should write the Central Electric Company for copies of "Bargains in Fan Motors and Ventilating Fans."

The Williams-Abbott Electric Company, Cleveland, Ohio, has just issued a new circular descriptive of its standard magneto bells of various kinds, the Sands bipolar receiver, the Barr long-arm transmitter, power generators, and the new complete telephone which this company is just putting on the market. This company claims to be able to manufacture and produce an absolutely high-grade telephone and place it on the market at a much lower price than other companies.

The Keystone Electrical Instrument Company, Ninth street and Montgomery

avenue, Philadelphia, are manufacturers of an unusually extensive and accurate line of electrical measuring instruments. Their standard types include instruments for every possible electrical service, and each instrument is tested and guaranteed. The company has just completed the most successful year of its business career, and in 1899 trebled the business it did during the previous year. A comprehensive catalogue of electrical measuring instruments may be obtained, free of charge, by addressing the company as above.

"The Transmission of Power by Leather Belting" is the title of a little catalogue issued by the Jewell Belting Company, Hartford, Ct., which will be sent on application. One of its features is the description and history of the oldest leather belt in the world which, according to figures, has traveled over 1,250,000 miles. This company manufactures belts bearing the well-known "Jewell" trademark, also the belt known as the "Hartford."

The factory of the Shelby Electric Company, at Shelby, Ohio, was visited a few days ago by a representative of this journal and in an interview with Mr. J. C. Fish, of the company, learned that it was now receiving the heaviest call for Shelby incandescent lamps since its organization. It is evident that this incandescent lamp is meeting with general success throughout the country—in fact, throughout the world, as its foreign shipments have been extremely large during the past months.

The Columbia Incandescent Lamp Company, of St. Louis, is not only turning out a large part of the incandescent lamps used in the United States, but is paying special attention to export orders. These lamps, as is well known, have stood the time test of years, and the claim of the management that they are "unequaled in quality" would seem to be proven by their popularity. This company has branch offices in all the large cities, and makes special claims for uniformity in initial voltage and uniformity in initial efficiency, as well as for the longest average life.

The Connecticut Telephone and Electric Company, of Meriden, Ct., last week made shipments of its apparatus to Canada, Jamaica, Cuba, New Zealand and an invoice of 12,000 pounds weight to Chili. The company states: "Our foreign business has increased very rapidly within the last few months, and to such an extent that we are doubling our entire capacity and expect to be in position by the middle of January to fill promptly any orders which we may receive. The demand for our type 'C' desk set, which we recently placed on the market, has been much greater than we anticipated, thus proving that the instrument is all we claim for it."

The Simplex Electrical Company, Cambridgeport, Mass., manufacture, under the patents of the American Electric Heating Corporation, electrical heating goods of all kinds for the house and toilet, as well as modern electric car heaters of some fourteen different forms. The numerous forms are to meet the requirements of all the various car seatings. The general manager of the American Electric Heating Corporation is Mr. James I. Ayer, widely known in the electric lighting field, and who, for the last few years, has devoted himself to the advancement of this interesting branch of electricity. The company is issuing a number of catalogues which also describe its enamel rheostats and dimmers used for all purposes.

William Roche, manufacturer of the "New Standard" dry batteries, 42 Vesey street, New York, is making a cell, similar to the French cell, for automobiles. This firm has recently patented a split-post connector in which the connection is made by slipping the wire into a slot and rolling down the binding nut, making a wedging contact on both sides and bottom of post, thus obtaining a perfectly true and accurate contact. The general success of these "new standard" cells has been so great that a branch office has been opened at 46 Clerkwell road, London, for the care of the European interests. Mr. Roche announces that soon he will have perfected a new cell of 2.1 volts and from 50 to 150-ampere-hours' capacity.

The International Correspondence Schools, of Scranton, Pa., turned out, up to September, 1899, no less than 112,000 students and graduates. Their electrical courses now include all varieties of work in engineering from bell work to electric mining and power transmission courses. The electrical classes are in charge of Mr. R. B. Williamson, formerly professor of electricity in Lehigh University. The number of foreign students enrolled in the electrical and other classes has increased greatly of late, and the instruction sheets sent out from Scranton now go to nearly every civilized country in the world. One of the peculiar advantages of this method of learning engineering is that it is just as available for a student in a foreign country as for one at home.

A Great Electrical Office and Factory Building—The twelve-story extension of the Western Electric Company, at Bethune and West streets, New York, was completed this week, forming a hollow square of stately factory buildings of the same height with offices on the top floors. Some 3,000 employés are required in carrying on the immense business of the company at this point, and the design and construction of the building, by Eidlitz, make it convenient for systematic work throughout. The offices of the manager, H. B. Thayer, and assistant managers, A. L. Salt and F. H. Wilkins, are on the twelfth floor, and comprise every convenience, in addition to beautiful and interesting window views of the Hudson River, New York Bay and the metropolis. President E. M. Barton, whose headquarters are at the Chicago house, has, however, a private office in the new building.

The Warren Electric and Specialty Company, Warren, Ohio, has introduced a curious innovation in the color of finishing the "Peerless" transformer, as they are sent out coated with aluminum paint, unless a dark color is specifically desired. This is done with the idea that the use of this paint increases the radiating power of the surface and assists in keeping the machine cool. This transformer for electric lighting, within the short time that it has been on the market, has received many splendid indorsements. The principle of its construction is in having the core consist of two upright bundles of laminated sheet-iron, with similar bundles connecting the top and bottom. The coils are of smooth, rounded shape, and the surface of separation between primary and secondary coils has been minimized. The company has recently constructed a new addition for transformer-making, which is operated as an addition to the "Peerless" incandescent lamp factory.

The electrical supply establishment of the Michigan Electric Company, at Detroit, Mich., is one of the most systematically and comprehensively arranged electrical centres in America. The method of departmentizing as devised and carried out by this company is largely the idea of the president, Mr. Joseph E. Lockwood, who, before the construction of the new building, visited many large department stores throughout the country in search of ideas. The theory of the conduct of this business is that everything electrical may find headquarters there. Under the one roof are repair shops, construction departments for several kinds of work, such as the making of electric signs, etc., the engineering department and the supply department for the sale of electrical apparatus and specialties for electric railway, lighting and telephony. This company also accepts contracts for the entire construction and equipment of electric plants and, in necessary cases, furnishes machinery especially designed by its own engineers.

In a recent interview, Mr. F. C. Phillips, president and general manager of the Elwell-Parker Electric Company of America, Cleveland, Ohio, stated that this company was operating its shops with a large complement of men and was taxing all facilities in meeting orders. This company gives specific attention to small direct-connected generating sets, motors for electric cranes, hoisting machinery, pumps and machines for this character of service. It has recently perfected a standard automobile motor that is producing excellent results, inasmuch as it will run with no sparking on any load, standing overloading without all the requirements of regular automobile service, yet suffering no overheating. The company is also producing a large number of direct connected generators of 250-kilowatt capacity and less; low-speed motors in the smaller sizes for direct connection to line shafting or to the shafts of driven machinery. The machine which the company at present has standardized is a machine that will yield at 150 revolutions per minute 10 horse-power, or 7½ horse-power per 100 revolutions per minute, and it can furnish this machine at various speeds from 100 to 300 revolutions per minute. At the latter speed it would give 22½ horse-power, and could probably go to 350 or 400 revolutions per minute with a corresponding increase in horse-power. This is an eight-pole machine.

ADVANCE INFORMATION.

Electric Railways.

TRENTON, N. J.—The Township Committee of Hamilton Township has granted a franchise to the Trenton Street Railway Company to extend its line from Yardville to Allentown, N. J. The line from Trenton to Yardville is already in operation.

BRATTLEBORO, N. H.—A new trolley project is now under consideration. It is to run an electric line from Brattleboro to Keene, N. H., a distance of 26 miles, passing through the villages of Hinsdale, Ashuelot, Winchester, Westport and West Swanzey. Boston electric railroad men are interested in the matter. Should this scheme be carried out, it is not improbable that the line may finally be extended from Keene down to Winchendon, and thence it will be but a short step to connect with the road at Templeton.

MIDDLEBORO, MASS.—The selectmen of Middleboro have granted the petition of the Middleboro, Wareham & Buzzard's Bay Street Railway for a franchise in this town. It is anticipated that this will quickly bring the contest among this company, the Onset Bay & New Bedford line and the Freetown line to a definite solution. All three companies are fighting for a right into Onset Bay.

CAMDEN, N. J.—The Camden & Suburban Railway Company is making extensive improvements to its power house and machinery on Cooper's Creek, on the south side of Federal street bridge, which, when completed, will make it the best equipped power house in South Jersey.

SPRINGFIELD, ILL.—The Los Angeles Traction Company, of Jacksonville, Ill., has increased its capital from $250,000 to $500,000.

GLASGOW, KY.—Articles of incorporation are asked for the Glasgow Railway Company, with a capital stock of $100,000. H. C. Trigg, W. L. Porter and T. P. Dickinson are the principal incorporators, and set forth that the purpose is to make a connecting road from Glasgow Junction to Glasgow.

LIMA, OHIO—The Bellefontaine, Kenton & Lima Railroad Company, of Lima, has been incorporated; capital, $100,000; incorporators, W. H. Miller, F. B. Williams, R. G. Furguson, R. Dunlap, J. K. Pierson, O. W. Williams.

Telephone and Telegraph.

READING, PA.—The Berks County Telephone Company has been chartered at Dover, Del., with a capital stock of $300,000. It is said that if Reading's Councils grant the new company a franchise, operations will be begun at once, and the new company will extend its lines to Wilmington, to connect with the Delmarvia company there, from where connection will be made with Baltimore, the central station for the eastern and western lines of a proposed big company.

WILMINGTON, DEL. — The American Independent Telephone Company, of Wilmington, has been chartered to construct and operate telephone and telegraph lines; capital, $100,000; incorporators, E. T. Canby, C. W. Smith, J. L. O'Neill, all of Wilmington.

DARRTOWN, OHIO — The Darrtown Telephone Company has been incorporated to construct and operate telephone lines; capital, $3,000; incorporators, L. A. Miller, F. S. Butler, J. Bufleson, G. Wagenfield, J. F. Mee.

Electric Light and Power.

EL PASO, COL.—The Golden Crescent Water and Light Company has filed articles of incorporation, the capital stock being $50,000. The company will operate in El Paso, Teller and Fremont counties, and the principal office will be at Victor. The incorporators and directors for the first year are Warren Woods, H. E. Woods and F. M. Woods.

SAN FRANCISCO, CAL.—The California Gold Mining and Electric Power Company, of San Francisco, has been incorporated, with a capital of $200,000; incorporators, J. C. Jens, A. H. Rich, J. R. Turner, all of Belmont; G. Gall, N. Hanson, both of San Francisco.

RACINE, WIS.—An ordinance has been introduced in the City Council in favor of granting to ex-Mayor M. M. Secor the right to build, maintain and operate an electric lighting plant in the city of Racine. The plant will be operated in opposition to the Milwaukee company.

COLLINWOOD, OHIO—The village of Collinwood is making plans for extensive improvements. A complete electric light plant, to be owned and operated by the village, is to be put in, ready for operation in June, this year. There are to be sixty-three arc lights in the village. For these improvements $18,000 worth of four per cent bonds have been issued. In addition a system of drainage is also being talked of.

DOWNERS GROVE, ILL.—The Downers Grove Electric Light Company, of Downers Grove, has been chartered for operating electric light plants. Capital, $2,500. Incorporators, W. A. Tape, J. Klein, W. H. Edwards, all of Downers Grove.

Miscellaneous.

NEWPORT NEWS, VA.—The Newport News Conduit Company has been chartered with a capital of $100,000 and the following officers: City-Treasurer J. M. Curtis, president; O. B. Batchelor, vice-president; B. J. Pressey, treasurer; W. Lee Powell, secretary. The company has made application to the Council for a franchise to operate in the principal streets, guaranteeing to complete its conduits on the streets, where paving is to be done, before this improvement is made. The company is authorized, after first obtaining permission of the proper municipal authorities, to construct an underground system of conduits for conveying electricity in Newport News, Hampton and suburbs.

CRIPPLE CREEK, COL.—The People's Electric Company has been formed at Cripple Creek to deal in electrical supplies; capital, $50,000; incorporators, M. S. Boal, H. L. Shepherd, E. Bell, all of Cripple Creek.

PORTLAND, ME.—The Marshall-Sanders Company has been organized at Portland for the purpose of manufacturing electrical apparatus, with $50,000 capital stock, of which nothing is paid in. The officers are, president, C. M. Drummond, of Portland, Me.; treasurer, J. M. Drummond, Jr., of Portland, Me.

HOLIDAY SOUVENIRS.

The W. R. Garton Company, Chicago, dealers in electrical and mechanical supplies, are sending out a calendar indicating neatly that they are "wide-awake" to their customers' interests every day in the year.

The Bullock Electric Manufacturing Company, Cincinnati, Ohio, expresses New Year's greetings to its friends in a little card calendar for January, which is as handsome a bit of color work as one often sees.

The James Kempster Printing Company, 117 to 121 Liberty street, New York city, is favoring its friends with its usual handsome desk calendar. This is one of the most tastefully prepared daily reminders received by the ELECTRICAL REVIEW.

Mr. Henry L. Shippy, secretary of the John A. Roebling's Sons Company, New York city, is remembering his friends with souvenir pocket memorandum books, with separate pads for each calendar month. It is an elegant and ingeniously prepared holiday reminder.

The Direct United States Cable Company, Limited, 40 Broadway, New York city, is sending to its friends a tastefully prepared wall calendar, with a daily memorandum pad attached. The calendar is designed to urge upon the public at large the advisability of marking their cablegrams "via Direct Cable."

The Okonite Company, Limited, 253 Broadway, New York city, is sending to its many patrons and friends a neat device in the form of miniature calendars attached to photographs of places of historic interest in Great Britain, such as Westminster Abbey, London Bridge, Charing Cross, etc. The idea is unique and is excellently carried out.

The American Electrical Works, Providence, R. I.—Eugene F. Phillips, general manager—is sending to its friends a very handsome steel-engraved calendar, carrying a portrait of Benjamin Franklin, with a brief sketch of his achievements on the back of the calendar. This is one of the most artistic productions that the ELECTRICAL REVIEW has received this season.

ELECTRICAL PATENTS.

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED DECEMBER 19, 1899.

639,276 Electric transformer; J. W. Packard, Warren, Ohio.

639,291 Automatic telephone; F. E. Ries, New York, N. Y. – Consists of an apparatus for telephonic communication, of a single portable apparatus embodying the signal controlling device and circuit-changing and receiving mechanism, of a telephone station combined as described to successively perform their signaling, circuit-changing and receiving functions by the act of grasping and lifting the said apparatus to the ear.

639,331 639,332 639,333 Machine for treating incandescent mantles; James H. Abercrombie, Newark, N. J.

639,372 Reflector for incandescent lamps; E. F. Gennett, New York, N. Y.

639,443 Electrically driven spindle; H. B. Sawyer, Newton, and R. Robb, Concord, Mass.

639,447 Alternating-current magnet; W. M. Scott, Philadelphia, Pa.

639,452 Graphophone; G. T. Smallwood, Washington, D. C.

639,459 Electric ground detector for constant-current arc-light circuits; J. F. Stevens, Philadelphia, Pa.

639,464 Coupling for electric or other wires; Rolland Thompson, Newark, N. J.

639,490 Automobile; T. R. Almond, Dunwoodie Heights, N. Y.

639,505 Electrical transformer; A. F. Berry, Market-Harborough, England.

639,527 Drop-restoring device for telephone switchboards; Frank B. Cook, Chicago, Ill.

(To be Continued.)

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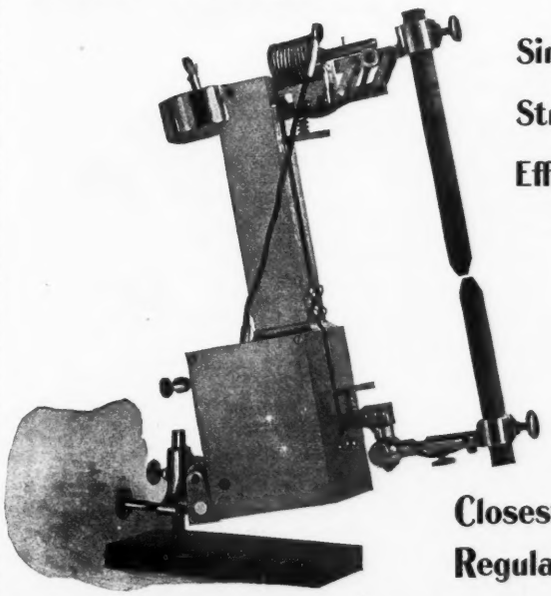
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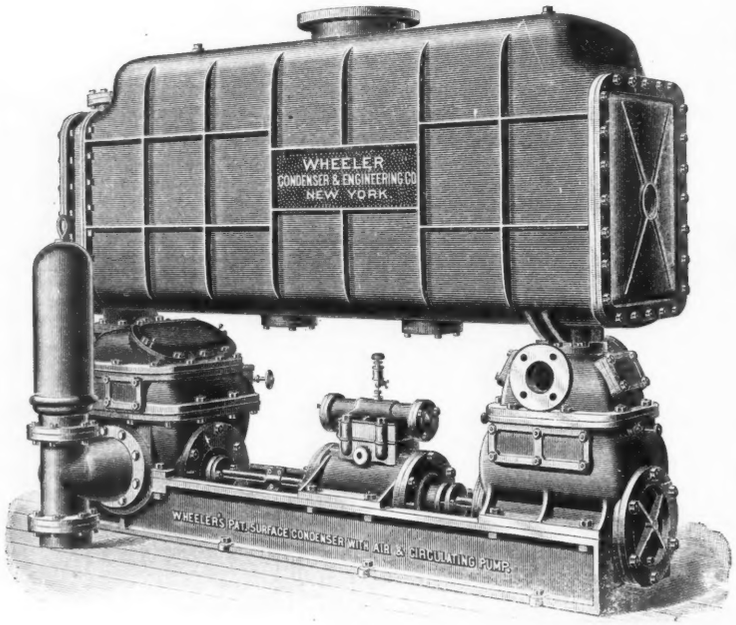

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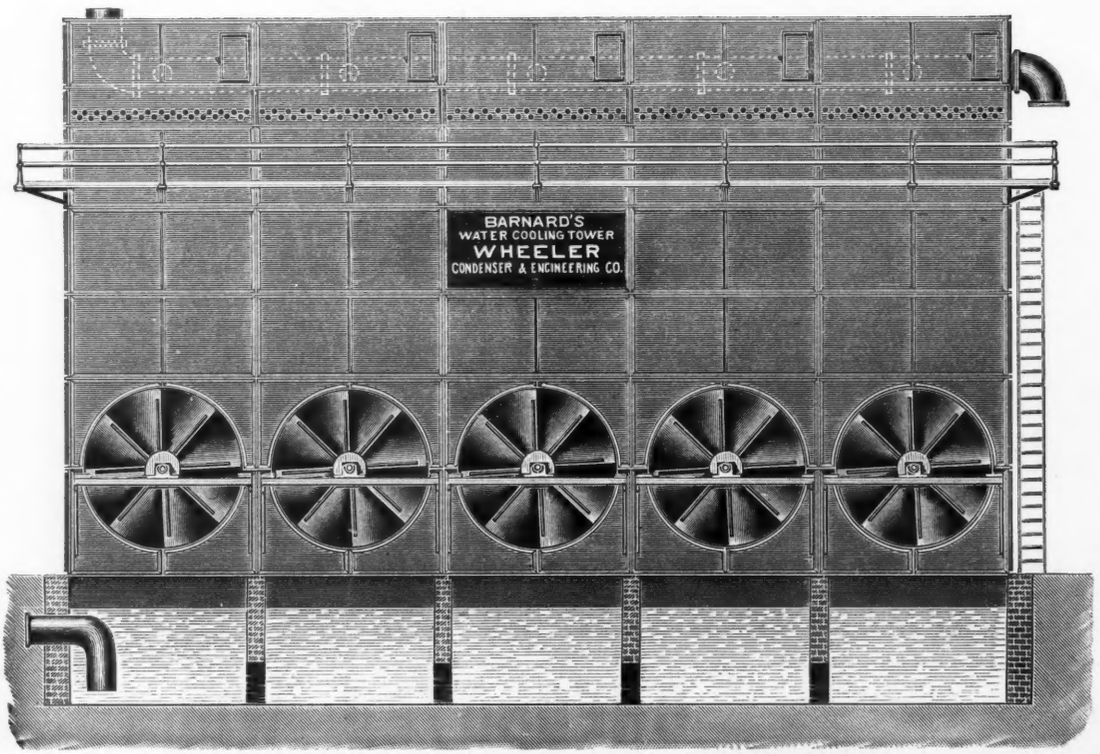

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